THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 29. Thursday, February 7, 1924. No. 390.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI,
LONDON, W.C.2.

Contents.

	PAGE
Recruiting Foundry Apprentices	103
Correspondence	104-116
British Chemical Standards	104
The Wellman-Smith Owen Engineering Corporation Staff Dinner	104
Patent Specifications	104
The Measurement of Power Gas	106
The Cardiff Propaganda Meeting	110
The Late Sir George Bean, J.P.	112
Discussion on Mr. Bartlett's Paper, "A Day at the Cupola"	113
Reinforced Cast Iron	117
Personal	117
Institute of British Foundrymen	118
Trade Talk	120
Company News	120
Contracts Open	120
Iron and Steel Markets	122

Forthcoming Events.

FEBRUARY 9.

Institute of British Foundrymen (London Branch):—Ordinary meeting in London. "Moulding Sands," Paper by Major A. Rhydderch.

Institute of British Foundrymen (Scottish Branch):—Ordinary meeting at Glasgow. "Co-operation between Pattern Shop and Foundry," Paper by H. M. Hodgart.

FEBRUARY 12.

Institution of Welding Engineers:—Ordinary meeting in London. "Some Chemical Aspects of Welding," Paper by J. R. Booer, B.Sc., F.C.S.

Sheffield Metallurgical Association:—Ordinary meeting at Sheffield. "The Flow of Gases in Furnaces as a Function of their Temperature Drop," Paper by H. Southern.

Institute of Metals (Birmingham Local Section):—Discussion upon "Waste Products and Losses in the Non-Ferrous Metal Industry."

FEBRUARY 14.

Institute of British Foundrymen (Birmingham Branch):—Ordinary meeting at Birmingham. "Some Important Adjustments between the Foundry and Drawing Office," Paper by E. Ronceray.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT, 1923-24, Oliver Stubbs, M.I.Mech.E., Openshaw, Manchester.

LIST OF SECRETARIES—

General Secretary: W. G. Hollinworth, 38, Victoria Street, London, S.W.1.
Lancashire: T. Makemson, 21, Beresford Road, Gorse Hill, Stretford, Manchester.
Birmingham: H. James Roe, 33, Herbert Road, Bearwood, Birmingham.
Sheffield and District: W. A. Macdonald, 62, Bannerdale Road, Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
London: H. G. Sommerfield, Woodhouse Road, N.12.
Newcastle-on-Tyne: H. A. J. Rang, 2, St. Nicholas Buildings, Newcastle-on-Tyne.
East Midlands: H. Bunting, 17, Marcus Street, Derby.
Coventry: J. M. Meston, 37, Melville Road.
West Riding of Yorkshire Branch: A. Love, 232, Gladstone Street, Bradford.

Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 20, Fisher Street, Swansea.

Recruiting Foundry Apprentices.

Speaking at the annual social gathering of the Lancashire Branch of the Institute of British Foundrymen last Saturday, Mr. Oliver Stubbs, the President of the Institute, laid great stress on the urgency of the solution to the question of the best methods to employ to get suitable boys into the foundry. An important meeting of foundry owners is to be held in the near future to consider what steps should be taken.

Any meeting held to discuss this question has to face the following facts:—(i) that a definite prejudice exists amongst craftsmen to place their boys into the moulding trade; (ii) that apprentices cost money whilst being properly trained; (iii) that working conditions must be materially improved; (iv) that any scheme formulated must have national application; (v) that parents throughout the land must be convinced that better conditions have been instituted; (vi) that any scheme must have the full approval of the trade unions concerned.

If foundrymen are prepared to admit that considerable prejudice does exist, then they must be likewise prepared to take drastic measures to overcome that prejudice. They must be prepared to guarantee parents that no boy shall leave the shop in a dirty condition. Working clothes must be provided by the employer, who likewise must be responsible for their sanitary condition; adequate clothing should be provided from a national fund, and of a suitable standard pattern. Foundries in which the character of the work is such that it affords but little variety of work, as in a railway chair foundry, should pay their quota to have moulders trained in a more suitable establis ment, because, after all, they require fully skilled foremen and charge hands if a change of process or means of production is effected. If it is decided that, from a sense of equity, the problem is to be tackled nationally, then it must be incumbent on every foundry to train or subscribe for the training of one apprentice for every ten skilled or semi-skilled moulders employed, or at some other pre-determined ratio.

At the moment it is grossly unfair for the Metropolitan-Vickers, British Thomson-Houston, Halls of Dartford, Flavell of Leamington, and a number of other enterprising concerns to train skilled moulders for the benefit of the industry as a whole.

We do not expect that it will be possible to get every foundry interested in a national scheme for foundry apprenticeship, but they will draw on the labour so trained in a few years' time, or go out of business. Dissentients from the scheme might profitably be asked if they would be willing to sign an agreement that they will never employ a nationally certificated moulder until they have been participants in the scheme for five years.

The importance of this subject cannot be overestimated. It is really a national problem. Engineers and other users of castings have already forgotten the creeping paralysis which was steadily killing British industry as a result of the moulders' strike. One can readily imagine British industry, and also that of every other country, being seriously hampered in the future, for every important manufacturing country in the world is experiencing the same difficulty, and to the one which first successfully surmounts it, will go the cream of the world's trade.

The sooner that the "man in the street" realises that the foundry is an essential public service and a key industry, and, as such, requires the fullest support of the Government and others, the better will the position of this country be to compete in the world's markets.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Action of Molten Brass on Nickel Steel.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Having read with keen interest your valuable abstract of the Paper on "The Action of Molten Brass on Nickel Steel," by Mr. H. M. Duncan, and as certain aspects seem to have been missed by the author, and have not been referred to in the discussion, the writer ventures to draw attention to what must be an important factor in such a research.

The author of the Paper may be able to throw light on the thing that seems lacking.

(1) It was noted that whilst some samples of steel containing from 1 to 5 per cent. nickel when heated in molten brass 1,000-1,050 deg. C. were found to crack, another consignment of 5 per cent. Ni steel stood heating to that temperature in brass without damage.

The abstract gives no details as to the processes by which the different steels were made.

(2) It was noted that 25 and 36 per cent. Ni-alloys did not crack when heated as above, and the conclusion is drawn that, therefore, steels containing high percentages of nickel, as well as those containing little, are free from the cracking trouble.

Again, the method of production is not given: and, as is well known, high nickel alloys made in a graphite crucible are very different from the average sort of alloy one might expect to be turned out of an electric furnace.

The former nearly always is high in carbon, and sometimes even contains graphite, while in the case of the product of an electric furnace there is no reason why carbon should not be reduced to very low limits. Again, when comparing a pot-made steel (and the high-Ni-alloys may easily have been pot alloys) with steel made by almost any other process you come straight up against the fact that pot steel may be nearly free from slag enclosures, whereas steels made by most other processes are subject to them. In general, what the writer wishes to bring out is this: In making a comparison of the kind made by Mr. Duncan it is necessary to be certain of many other things besides chemical composition.—Yours, etc.,

H. GRATTAN.

Adelaide Road, Dublin.

The Institute of Metals.

The annual general meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, on March 12 and 13. The presidential address will be delivered by Professor T. Turner, M.Sc., A.R.S.M., in the morning of March 12. No fewer than fourteen communications—many of a very important character—are due for presentation and discussion at the meeting. The annual dinner of the Institute will be held at the Trocadero Restaurant on Wednesday, March 12.

In connection with the forthcoming meeting, a ballot for the election of members and student members will be taken at noon on February 28. Persons elected as a result of the ballot will have the privilege of membership, not for the usual twelve months, but for the extended period ending June 30, 1925. In addition, new members and students will be entitled to receive an extra copy of the "Journal," making three volumes in all, during the period covered by their subscription. Membership application forms and full particulars regarding the Institute can be obtained on application to the Secretary, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, Westminster, S.W.1.

It is of interest to note—for the first time in the Institute's history—the membership passed the 1,500 mark on December 31, 1923. It is hoped by the Council that, as a result of the many activities of the Institute during the present year—particularly in connection with the British Empire Exhibition—this figure will be substantially increased before the end of 1924.

British Chemical Standards.

The organisers of the British Chemical Standard movement announce the publication of the complete certificate of analyses of the following samples:—

	Carbon steel "C."	Carbon steel "P."	Cast iron "D."
	Per cent.	Per cent.	Per cent.
C.	0.091	0.205	—
S.	—	0.072	—
P.	—	0.105	1.19
Mn.	0.50 approx.	0.706	—

The samples were first issued about eight months ago, but it has not been possible to publish the full details of all the figures until now.

Each of the standard steels has been tested by a selection of about a dozen prominent chemists, representing independent analysts (metallurgical); U.S. Bureau of Standards; English, French, Italian and United States iron and steel works chemists (both makers and users).

A special feature of steel "P" certificate is that it contains full notes of the methods actually used by the co-operating analysts.

The standard samples may be obtained in 50-, 100-, and 500-gramme bottles, either direct from Organising Headquarters, 3, Wilson Street, Middlesbrough, or through any of the leading laboratory furnishers, at a price just sufficient to cover the cost. The usual certificate giving the names if the analysts, the types of methods used, and a detailed list of the results, will be supplied with each bottle.

The full list of all the standards now available may be had on request.

The Wellman Smith Owen Engineering Corporation Staff Dinner.

Held at the Euston Hotel last Monday, this function provided an opportunity for the staff to meet the new chairman of directors, Sir Godfrey M. Paine, K.C.B., M.V.O., who presided.

The toast of "The Corporation" was given by Col. W. F. Cheesewright, D.S.O., one of the proprietors of THE FOUNDRY TRADE JOURNAL, who outlined the growth of the Corporation and the many innovations it had created for the engineering and metallurgical industries of Great Britain. After Mr. James Smith had replied, Sir Godfrey Paine proposed "The Staff," to which Mr. Stuart Matthews replied. The whole of an excellent musical programme was provided by the staff.

Patent Specifications.

Particulars of Complete Specifications Accepted, furnished by Mr. Eric Potter, Patent Agent, of 27, Chancery Lane, London, W.C.2. Printed copies of the specifications in the following list are now on sale.

BROOKFIELD, D. Machines for casting metal. No. 209,876.

BEARDSLEY, E. O., and PIPER, W. F. Foundry moulding machines. No. 210,025.

MR. R. DYSON, of Owen & Dyson, Limited, Rother Iron Works, Rotherham, died recently at his residence, Fairfield, Moorgate, Rotherham. He was 83 years of age.

Oxygenated Blast.—M. Derclaye, in a contribution to a recent issue of the "Revue de Métallurgie," comes to the conclusion that in practice nothing is gained by adding more oxygen to the blast than the quantity which brings up the total O content in the blast to 26 per cent.; the saving in pure carbon in this case amounts to about 100 kg. (say 2 cwt.) per metric ton of pig-iron. This is self-evident if one bears in mind that the oxygen does not add to the calorific value of the blast, but a small quantity of it merely reduces the index CO_2/CO to its practical limit of carbon saving. Having reached this limit no further saving can be expected by adding more oxygen.

The Measurement of Power Gas.

By Major F. Johnson Taylor.

[Though Major Taylor's article is primarily intended to deal with power gas, much of it is directly applicable to cupola practice. Foundrymen invariably measure in some way all materials entering the cupola except air—yet this is probably the most important of all, because the whole success of cupola working depends upon the quantity admitted. To those foundries using power gas as motive power, this article is of double interest.—ED.]

Introduction.

In the case of comparatively small engines working on town gas, the amount used can be obtained directly from the readings of the gas meter which, dealing with clean, cool gas, is accurate within commercial limits. As most engines above 20 h.p. work on producer gas, and in the case of large engines blast-furnace and coke-oven gas, some method of checking the gas consumption of the engines is essential if the plant is to be run on efficient lines. Of course, in the case of a producer installation, the whole purpose of which is to provide gas for the engines, the coal consumption of the producer per b.h.p.-hour given by the engines is the vital factor in the economical running of the whole in the same way as the coal burned in a boiler per h.p.-hour or kw.-hour developed by the engine or turbine is the determining factor in the efficiency of a steam plant. However, unless the volume of gas produced per ton of coal is on record, the relative efficiency of engines and producers cannot be calculated, and therefore modern gas-power plants should possess some means whereby the amount of gas generated can be determined with reasonable accuracy.

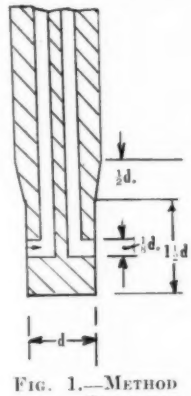


FIG. 1.—METHOD OF OBTAINING INCREASED VELOCITY HEAD WITH PITOT-TUBE GAS MEASUREMENT.

The ordinary commercial gas-meter is incapable of dealing with power gas, on account of its heat and the dirt and tar, etc., it contains. The volume passing through the gas main can be determined either by: (1) Estimation in the case of engines; (2) Pitot tubes; (3) orifices; (4) venturi tubes, or (5) electro-flow meters.

Principles of Operation.

Leaving out for the present (1), the orthodox commercial gas-meter is a displacement meter in some form and is therefore a positive meter, but those suitable for the measurement of power gas depend for their operation upon a difference of pressure created in the pipe line. In the case of (2) this is the pressure difference between the two elements of the Pitot tube; in the case of (3) it is the difference of pressure on the two sides of an orifice plate; in the case of (4) it is the pressure difference in between either end of a convergent nozzle; and in the case of (5) the pressure difference in a hyperbolic elbow.

It is well established by the laws governing the flow of gases that this pressure difference is a measure of the velocity of flow of gas (including air or steam) in a pipe. The mathematical theory is somewhat complicated and need not be gone into here; suffice to say that types (2) and (3) are comparatively inexpensive instruments but are sufficiently accurate for many purposes, while (4) and (5) are more or less costly and may be regarded as commercially accurate if not strictly scientifically accurate.

Estimation of Gas Flow.

There are various methods whereby the flow of gas from producers can be estimated. Of these that by analysis for ammonia content and by carbon balance may just be mentioned, although they concern the chemist rather than the engineer. The first named is applicable to ammonia-recovery plants and is useful when means are available for getting the data as a check on other methods.

Carbon-balance Method.—For hot non-recovery gas, the carbon-balance method, when systematic and continuous records are kept, is fairly reliable and consists in balancing the carbon content of the coal against that of the gas combined with ashes, tar, dust, etc. That is to say, if C is the weight of carbon which actually appears as gas in lbs. per ton of coal, and S the percentage $CO_2 + CO + CH_4$, then

Volume of gas per ton coal = $100C/S \times 32.06$.

Piston Displacement on Suction Stroke.—If the composition of the gas is known, the volume of gas used can be determined by this method, but admittedly, for accuracy the temperature at the end of the suction stroke should be known. To assume that it is the same as that of the cooling water leaving the cylinders cannot be considered as accurate, and the temperature is much better calculated from the readings of volume, mixture proportion, and pressure which really represent a factor correcting the piston displacement volume for (*a*) temperature, (*b*) volume of exhaust gas occupying the unswept space, and (*c*) difference of pressure between that measured as described and the actual average pressure.

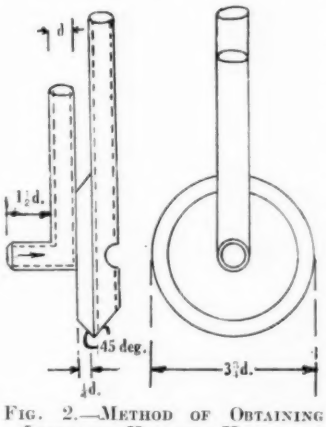


FIG. 2.—METHOD OF OBTAINING INCREASED VELOCITY HEAD WITH PITOT-TUBE MEASUREMENT OF GAS CONTAINING TAR, ETC.

The data required for estimating gas consumption by this method are: (1) Cylinder-volume swept out by piston; (2) proportion of gas-air in the mixture; (3) temperature of the mixture at the end of the suction-stroke; and (4) corresponding pressure. Then if

V = volume of gas used,
h = cylinder hours worked,
d = piston displacement volume,
p = pressure in cylinder at end of suction stroke.
t = temperature or correction factor,
R = ratio of volume of mixture to volume of gas,

$$\frac{V \times R \times (273 + t) \times 760}{288p} = hd \times \text{r.p.m.} \times 60/2.$$

from which $V = \dfrac{hd \times \text{r.p.m.} \times 30 \times 288 \times p}{R\ (273 + t) \times 760}$

The above formula assumes closure of exhaust and opening of inlet exactly at the end of the exhaust stroke, and for the pressure being constant throughout the suction stroke so that V is somewhat under-estimated owing to the expansion of the products of combustion during the suction stroke.

As regards R, assuming that there is no oxygen in the gas, the air required for the combustion of 100 volumes of gas is found by the equation,

$$\frac{100}{20.9}\left(0.5H_2 + 0.5\ CO + 2CH_4\right)$$

the latter part of the formula in brackets

being referred to later as "A." The volume of air actually used per 100 volumes of gas is calculated from the composition of the exhaust gas, this being assumed to contain no CO. The decrease of volume of the mixture after explosion when measured at ordinary temperatures, which is that under which the analysis would be carried out, would be as follows:—

$$\text{"B."} = (1.5\ H_2 + 0.5\ CO + 2CH_4)$$

Then if x = the percentage of oxygen and y = the percentage of CO_2 in the exhaust gases then

$$x = 100\ \frac{\frac{20.9}{100}\ V - \left(A\right)}{V + 100 - (B)}$$

V = volume of air used per 100 volumes of gas calculated from x:—

$$V = \frac{100\ x + 100\ (A) - x\ (B)}{20.9 - x}$$

Alternatively

$$\frac{V + 100 - (B)}{100} = \frac{CO_2 + CO + CH_4)}{x}$$

and calculated from y

$$V = 100\ \frac{(CO_2 + CO + CH_4)}{y} - 100 + (B)$$

Thus there are two values for V which, if the analyses are properly carried out, should be in close agreement.

Pitot-Tube Measurement of Gas.

Provided a suitable straight length of gas-main is available, the Pitot tube has advantages amongst which may be mentioned that of offering practically no resistance to flow, and of being unaffected by hot and dirty gas. Although the Pitot tube acts on the principle of a pressure difference, it differs from the orifice in this respect, that while the latter sets up a pressure difference the former makes use of the difference of pressure existing between one leg of the tube facing up stream and the other facing down stream. The principle has been extensively applied to the measurement of water gas and air. Recorders may be had to work in conjunction with Pitot tubes reading in either volume or velocity, but the results will only be correct for one temperature; but provided the average temperature is fairly constant, a simple correction may be applied for a small variation. One of the difficulties which beset the Pitot-tube method as applied to low-pressure gas-flow is the very small velocity-head obtainable with the ordinary impact hole facing up stream and a static-pressure hole parallel to the stream lines. A much better arrangement is that shown in Fig. 1, from which increased velocity head can be obtained. It merely consists of a circular rod drilled as shown. The suction hole in this kind of tip will give more reliable readings than either the impact hole or the static-pressure hole, because if either of these is deflected a few degrees out of parallel with the flow, considerable error is introduced, while that shown in Fig. 1 may be considerably out of position without producing any ill-effects.

The arrangement shown in Fig. 2 is well suited to gas containing tar and other depositable matter.

The velocity head for tips of the Pitot-tube class can be calculated when H = the Pitot head in inches of water, W = the weight of fluid passing in lbs. per cub. ft., V = velocity of fluid at tip in ft. per sec.

Then $H = WV^2/K$.

K being a constant, its value for the type shown in Fig. 1 is 210, and for that shown in Fig. 2 it is 250. These tips require accurately making according to the dimensions given, big pressure-pipes free from bends with liberally-dimensioned connections and valves being also essential to reduce friction.

The pressure difference created in a Pitot tube is registered in some form of manometer. Expressed in inches of water as h the velocity V of the gas in feet per second will be:

$$V = 66.1\sqrt{h}$$

then given the area of the pipe in sq. ft. = A, the volume passing is VA.

Manometers for Pitot Tubes.—The pressure difference from which the velocity of gas may be calculated may be recorded by a U-tube. One of the difficulties, however, in producing an easily-read manometer of the U-tube pattern is that as the flow varies as the square-root of the pressure difference, the scale of low rates of flow is very cramped. The curved-tube manometer gets over this difficulty to some extent by curving the tube to obtain an equally-spaced scale from about one-tenth of the maximum scale upwards. It provides an accurate and clear rate-of-flow indicator for use with Pitot tubes and with orifices at comparatively small expense. Curved-tube manometers may be had to work at four different maximum pressures from ½ in. to 4½ in. w.g., and these will give accurate readings down to one-eighth of maximum flow and down to one-sixteenth maximum flow in a special long-range form.

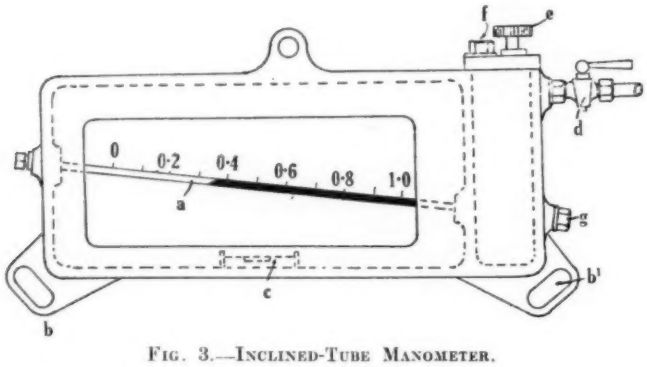


FIG. 3.—INCLINED-TUBE MANOMETER.

These instruments, which are made in celluloid (which is very suitable except for gas heavily charged with ammonia), have the special feature that there is no appreciable variation of the zero point with temperature changes, a feature not always obtainable with "sensitive" manometers. The curved-tube manometer is a commercial instrument made by George Kent, Limited, London, and can generally be recommended for average conditions. Super-sensitive types are obtainable, but they are more or less laboratory instruments, though they give much more accurate readings than the inclined water-tube. The Chattock tube is an electrical instrument, its principle of operation being the variation of the resistance of a wire according to temperature. It is extremely sensitive even to velocities of ½ ft. per sec., while the Wahlen gauge of American origin which is a new type of two-liquid instrument is still more sensitive.

Apart from the curved-tube manometer, which is a type often used with orifice-meters, the inclined-tube manometer as shown in Fig. 3 can be recommended for Pitot-tube work. The tube, as it will be seen, is mounted in a frame which is bolted to a wall. The slots *b* are for this purpose, and the instrument is provided with level *c* to ensure its proper setting. Cock *d* is for connection to the pipe line; *e* is a gland-packed adjusting screw, *f* the filling plug, and *g* the cleaning plug. This is a good, serviceable instrument for dealing with dirty gas, and combined with a simple Pitot tube provides a fairly accurate means of measuring flow at the minimum of expense.

Orifices.

The orifice method of gas measurement is simple, fairly accurate, and offers several advantages for small installations. It consists essentially of a thin plate interposed between two flanges of the gas main as shown in Fig. 5A. Two adjacent pipes are then connected to a manometer, preferably of the curved-tube type (Fig. 4) by small copper tubes. The varying position of the liquid column in the manometer, which is the measure of the velocity, depends upon the pressure difference existing between the two sides of the plate. The plate and its connections can be made by any good mechanic, but the orifice requires to be of an area properly proportioned to the average flow and to be accurately shaped, and forming, as it does, part of the instrument, is best made by the instrument makers. The orifice may vary in size from 1 in. to 30 in. The exact size of this hole in the plate is a matter for calculation.

Another form of plate orifice, which, as will be seen, does away with the necessity for drilling the pipes, is shown in Fig. 5B, and thus forms a compact unit which can be bolted up between the flanges. In this case the plate has to be made to slant slightly in order to give clear entry to the pressure holes, and it is equally important that the pressure pipes should have a regular slope free from sharp bends and fitted with drainage syphons. When dealing with hot gas, more or less dirty, it is a good plan to use a diaphragm made from 3-mm. steel plate, the edge of the orifice turning away from the gas flow being bevelled at an angle of 45 deg. The plate must, for accurate results, be situated in the middle of a long, straight pipe-line so as to allow any whirls due to bends, valves, etc., to subside; this length should not be less than 15 to 20 diameters of the pipe.

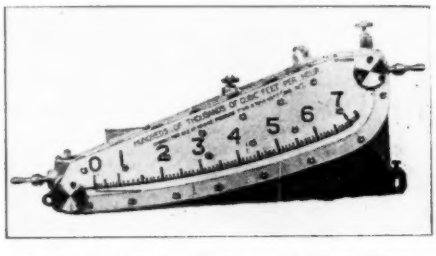


FIG. 4.—GENERAL VIEW OF CURVED-TUBE MANOMETER.

Formula for Plate Orifices.—The following formula is applicable to plate orifices, and is the German standard one for non-elastic fluids. Given: W = weight of gas flowing in kg. per sec.; c = flow coefficient; g = 9.81 m. per sec.; A = area or orifice in sq. m.; P and p = absolute hydrostatic pressure in kg. per sq. m. before the diaphragm and after the diaphragm respectively; w = weight in kg. of a cub. m. of gas at mean pressure and temperature at which the readings are taken; then $W = c.A.\sqrt{2g\,(P-p)\,w}$.

This formula applies when $P-p$ is small compared with the absolute pressure; that is when p closely approaches P. The volume of gas is given by the relation $V = W/w$ cub. m. per sec.

With a pressure difference between 20 to 150-mm. water column, and a diameter of orifice ¼ to ⅓ of the pipe diameter, a properly-calibrated plate will give true results within 1½ per cent. The following formula will give the quantity, Q in cub. ft. per min. when A = area of pipe stream, up-stream of the orifice in sq. in.; a = area of orifice in sq. in.; H = head across orifice in inches of water; P = absolute pressure lbs. per sq. in. in up-stream; T = absolute temperature.

$$Q = \frac{100\,A}{\sqrt{\left(\frac{A}{a}\right)^2 - 1}}\sqrt{\frac{HP}{T}}$$

For the measurement of dirty gas a self-cleaning orifice is now frequently adopted, because accuracy depends upon the orifice being clean and free from deposit. This orifice is fitted up in the same way as an ordinary plate-orifice, but incorporates a series of nozzles right round the edge of the orifice through which a cleansing liquid is discharged.

Venturi-Tube Meters.

The venturi principle has been applied to gas measurement with considerable success. The venturi tube is now well understood by engineers and a detailed explanation is unnecessary; suffice to say that while the orifice creates a pressure difference by reason of its insertion in the pipe line, the venturi creates it by reason of its being a convergent tube giving a higher velocity at the throat. The pressure difference between the up-stream end of the tube and the throat is made use of to operate the recorder. The whole instrument is a much more comprehensive arrangement than either a Pitot tube or an orifice, and is in consequence comparatively costly, but it is very accurate.

The venturi system is well known as a means of water measurement and to a certain extent of air measurement, but for gas its introduction is comparatively recent, special arrangements for dealing with deposits being necessary. Another difficulty which has been overcome is that due to the fact that the weight of gas per cub. ft. at any given pressure and temperature is somewhat indefinite, the registration of a venturi gas-meter depending upon the square root of the density of the fluid passing through it. For extreme accuracy a recorder can be had which automatically takes into account every variation in the sp. gr. of the gas, but as this is a costly instrument another type, used with a conversion table, will generally suffice for power-gas plants.

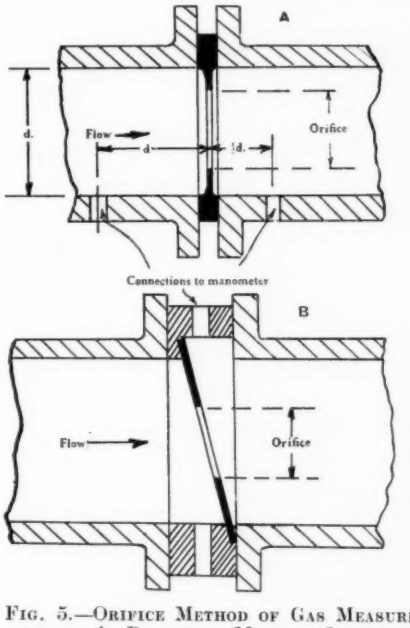


FIG. 5.—ORIFICE METHOD OF GAS MEASUREMENT, A DENOTING METHOD INVOLVING DRILLING OF PIPE, AND B WITH PLATE AND MANOMETER CONNECTIONS BETWEEN FLANGES.

The general arrangement of a venturi tube for gas measurement is shown in Fig. 6. It consists of a gradually-converging up-stream cone a, a short parallel throat section b, and a very gradually-diverging down-stream section c, the latter serving to reduce loss of pressure to a minimum. Throat b is steam-jacketed to prevent deposit, the pipes for this purpose being shown at e, while section b is made easily removable for cleaning. Owing to the smooth contour of the venturi tube, there is little liability to eddy-flow through it, a fact which reduces to a minimum the tendency to deposit, which is assisted by the high velocity therein and the accurate machining of this part of the meter. The vertical method of measurement has the advantage of taking up small space and a tendency to reduce deposit. There are three valves v, the purpose of which is obvious; the small pipes f lead to the recorder, while the drainage syphons are indicated by g.

XUM

Recorders.—Recorders are classified by the makers as A and B types. The A type is connected to the venturi tube by means of pressure pipes, and may be placed at any convenient distance away provided the pressure pipes are at least ¾ in. in dia., laid at a sufficient slope to drain, and fitted with drainage syphons at their lowest points. The recorder registers by counter and diagram the actual volume of gas which has passed, measured at the temperature and pressure which exist at the venturi tube. The counter mechanism will commence to register at one-twentieth of the full flow, and correct registration will be within 2 per cent. between one-tenth full flow and full flow.

To enable high accuracy to be maintained in practice, the meters must be designed so that every part may be inspected *in situ*, the venturi tube being installed on a by-pass as shown in

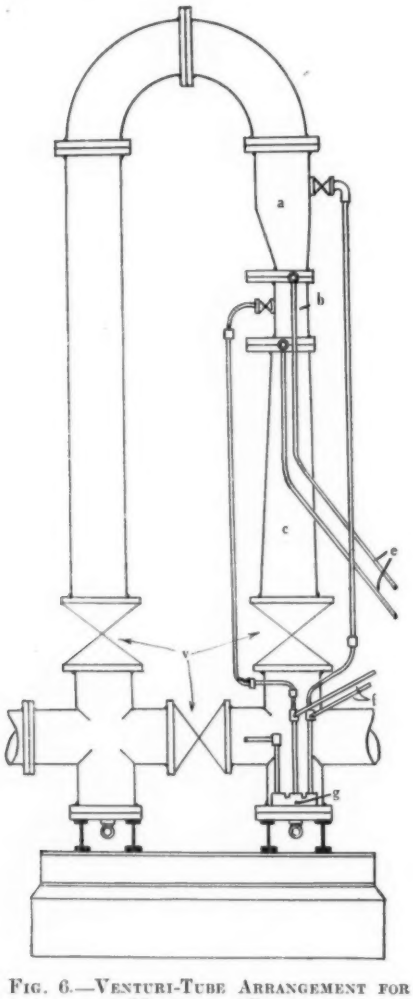


FIG. 6.—VENTURI-TUBE ARRANGEMENT FOR MEASURING GAS.

Fig. 6, and the throat-section being easily removable for inspection and cleaning. The principle upon which this type of meter works is as follows. The volume of gas passing through a venturi tube is directly proportional to the square-root of the pressure difference between the up-stream and throat portions of the tube and inversely proportional to the square-root of the density of the gas passing. In the recorder a sensitive bell measures the sensitive difference of pressure above referred to and a shaft whose speed (about 30 r.p.h.) is made inversely proportional to the square-root of the density of the gas passing, adds to the counter each time it rotates an amount proportional to the square-root of the differential pressure measured by the sensitive bell. Thus the actual volume of gas passed is shown by the counter record.

The B-type recorder consists of an inverted bell enclosed in a bell chamber and sealed by oil. The up-stream pressure is brought to the underside of the bell and the down-stream pressure to the inside of the bell chamber. The motion of the bell is taken out through the wall of the bell chamber by means of a spindle rotating in a gland, thus reducing to a minimum the friction opposing the motion and the consequent lag between the up and down readings. The bell is compensated for temperature changes, while its motion may be

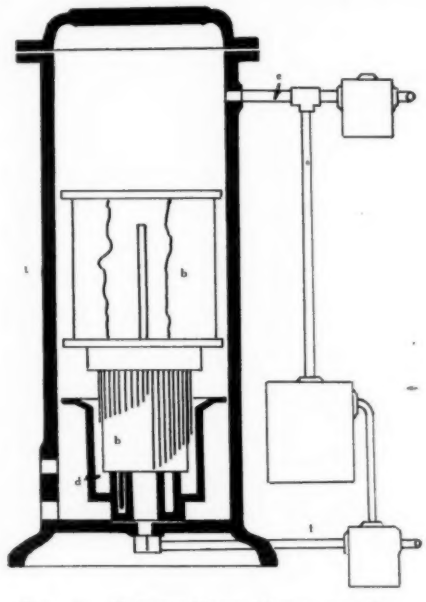


FIG. 7.—ELECTRO-FLOW METER FOR GAS MEASUREMENT.

damped in the case of pulsating flows. This recorder may be placed at a distance under the same conditions as the A type and the recording diagram may be of the disc or cylindrical pattern, the latter being generally used for intermittent flows, being rotated once in 24 hours. This diagram, in the absence of a counter-mechanism, would be integrated for total flow by a planimeter.

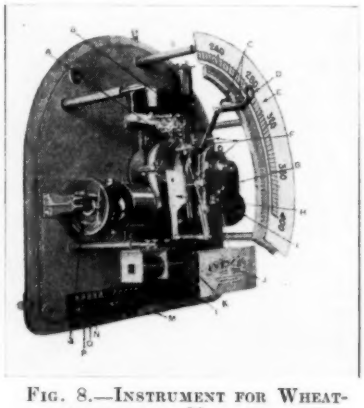


FIG. 8.—INSTRUMENT FOR WHEATSTONE-BRIDGE METHOD OF GAS MEASUREMENT.

A=Relay. B=Galvanometer. C=Balancing resistance contacts. D=Indicator. E=Scale. F=Integrator pawl and stops. G=Graphic pen. H=Pen segment. I=Generator. J=Integrator dials. K=Time motor. L=Electro magnet. M=Terminal blocks. N=From temperature plug. O=From meter body-pressure gauge-ground. P=From meter body. Q=Constant-speed governor.

The counter-mechanism, which of course adds to the expense of the installation, consists of an enclosed eight-day clock-train, which causes a spindle carrying a cam to make 30 r.p.h. The counter is driven off this spindle. A "style," whose position is set by the flow mechanism, determines, by the points at which it is lifted and dropped by the rotating cam, what amount is added to the counter train at each revolution. By this means a counter record of the flow pass-

ing is obtained. This recorder works on a 2-in. w.g.

Electro-Flow Meters.

The electro-flow meter is a comparatively recent innovation. One type involves the use of the hyperbolic elbow for creating the pressure difference, this being transmitted by pipes to the meter body which is electrically connected to the recorder. This hyperbolic elbow is in the form of a 90-deg. flanged elbow with the necessary pipe-outlets to the meter body. In addition, there are tappings in the side for four pipe-connections to a multi-manometer, so that simultaneous readings of pressure across the line of symmetry may be taken for testing purposes or for the purpose of verifying the value of the flow coefficient for any size of elbow. Inside the elbow are a series of grids made of monel metal, the purpose of which is to assist in controlling the conditions of flow. The flow coefficients, however, depend only upon the dimensions of the elbows.

The reason for the use of the hyperbolic elbow might at first seem obscure, but its main object is to maintain stream-line flow upon which a definite relation between pressure difference and velocity

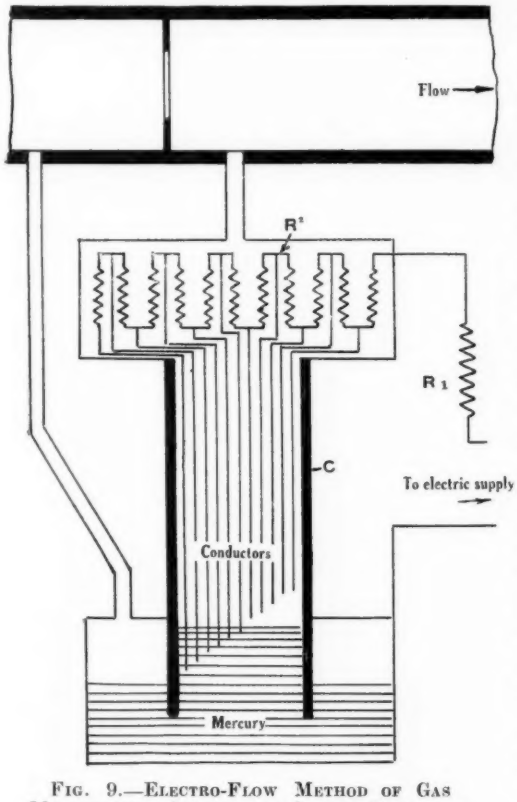


FIG. 9.—ELECTRO-FLOW METHOD OF GAS MEASUREMENT OPERATED ON ORIFICE PRINCIPLE.

depends. The exponents of this system claim that stream-line flow cannot exist in a commercial pipe, a contention supported by the results of Reynolds' experiments. This elbow, by breaking up the complicated flow and changing it into a stream-line flow, is claimed to ensure great accuracy. The parallel grids in the form of sharp metal planes facing the flow force the gas to move between them, while the curved form of the elbow enables a stable balance to be maintained between pressure, velocity, and centrifugal force.

The result is claimed to be a constant-flow coefficient, the formula for which is found in terms of elbow dimensions in the case of the hyperbolic elbow.

The pressure difference is transmitted by pipes to the meter body, which forms the connecting link between the elbow and the recorder. The arrangement is shown in Fig. 7. Inside the semi-steel shell *a* is a movable float *b* carrying nickel-steel contact rods, which are of graduated length and have resistances between them. These rods project into a well *d* partially filled with mercury. The upper portion of the float *b* floats in insulating oil, the lower part *b* floats in the mercury cup, while *e* and *f* are the pressure pipes, *e* transmitting the lower pressure.

From this apparatus there are two electrical connections to the recording mechanism, one is connected to the mercury and the other to the resistance element. It is easy to see that pressure difference causes a rise or fall of the float; the lower it is the more of the nickel contacts are immersed in the mercury, the more resistance is cut out from the electrical circuit, and the more current flows, and *vice versa*. This current operates the recorder. Thus there is no limit to the distance which the recorder may be from the meter body, and these meters are claimed to be accurate within from 1 to 2 per cent. at flows over 15 per cent. of normal, while even greater accuracy is obtainable with a super-sensitive type, which gives a contact movement of 2 in. for a pressure difference of $\frac{1}{5}$ in. w.g.

The recorder which is shown diagrammatically in Fig. 8 is purely an electrical piece of mechanism and makes use of a Wheatstone-bridge circuit for automatically measuring the electrical resistance in cubic feet or any other desired unit. The various resistance elements which are affected by the pressure difference, temperature and static pressure are connected in the Wheatstone-bridge circuit, and the act of balancing these resistances actuates the meter indicator. Thus, by measuring one balancing resistance, the recording mechanism automatically measures the pressure difference and at the same time obtains correction for all the variable elements in the fluid being measured, since the Wheatstone-bridge can be used to serve for automatic multiplication and division of these various factors. The current flowing through the circuit is very small, averaging 0.01 ampere. An electric motor operates the recording mechanism, its speed being controlled by a governor. This motor drives the generator supplying current to the Wheatstone-bridge circuit, and in addition it drives the indicator arm gearing and rotates the graphic chart. There is no clock. The main shaft of the recorder is rotated once every 5 sec. through a worm-gear driven from the motor. It carries a gear for rotating the indicator arm, a pawl for operating the integrator and a four-sided cam which raises a rocker arm every $1\frac{1}{4}$ sec. to rock the galvanometer relay.

Electro-Flow Meters Operating on Orifice Principle.—As before stated, the hyperbolic elbow is the means adopted in the hyperbo-flow meter for obtaining the necessary pressure difference. The orifice principle is also used and the diagram in Fig. 9 shows its operation. The system of electrical contacts, however, is essentially the same for all types of electro-flow meters. Referring to the diagram, the mercury column forms part of an electric circuit which contains a fixed external resistance R1 in series with a variable resistance R2. In contact chamber C, which forms a low-pressure side of the U tube, there are a number of conductors of varying lengths placed above a mercury column, and as the mercury rises it makes contact with one conductor after another. The variable resistance R2 is subdivided by these conductors into resistance steps so that the rise and fall of the mercury column varies the amount of resistance, and therefore regulates the amount of current passing through the circuit. Moreover, the resistances are so divided that the flow of the current in the circuit is directly proportional to the flow of gas in the pipe, so that the electrical instruments provided, while measuring the current regulated by the flow, actually register the amount of gas passing through the pipe. The total amount of electrical energy measured by the wattmeter (not shown) is the exact equivalent of the total amount of gas passing through the pipe, accuracy being ensured by using highly-sensitive electrical instruments. The latter, of course, having no mechanical connection whatever with the meter body are unaffected by temperature or dirt.

Cheap Fares to the British Industries Fair.—By an arrangement between the railway groups and the Department of Oversea Trade, the organisers of this fair, visitors will be able to make the return journey from anywhere in Great Britain at a cost of one and a third of the ordinary single fare.

The Cardiff Propaganda Meeting.

In opening the meeting, Mr. McClelland explained that owing to the railway strike the President, Mr. Oliver Stubbs, had been unable to get to Cardiff from Manchester. He therefore asked Mr. J. Ellis, of the Cardiff Foundry & Engineering Company, Limited, a Past-President of the Institute of British Foundrymen, to take the chair.

The Chairman's Address.

The Chairman said it was most desirable that we establish a Branch of the Institute of British Foundrymen in South Wales, and after many invitations Mr. McClelland had very kindly put his shoulder to the wheel and organised this meeting.

The Institute was established in 1904, and at the first meeting only seven turned up, so it is apparent that if there is but a small meeting to-night it must not discourage us. After all, the railway strike has seriously interfered with the arrangements. At the first Convention in Manchester 80 turned up, and to-day there was a membership of 1,650.

There have been about 900 Papers during the whole of the period, and in the early days 60 per cent. were theoretical in character. He, personally, objected to so much theory, and for a considerable period the proportion was reversed. The Papers at present are about equal.

The number of branches throughout Great Britain is nine. There are three sub-sections. Newcastle has a remarkable sub-section composed of all boys under the age of 18, and they run the Branch entirely by themselves. They have written to the General Council asking if they could participate in the Annual Convention. It is a very important matter, as the boys of to-day are the men of to-morrow, and unless we do something to educate apprentices and teach them all there is to be taught, there is not much hope for true progress.

The "Proceedings" have grown from a 16-page pamphlet, until to-day we get a volume, full of foundry matter, approximating 900 pages, so it is apparent the amount of Papers that are presented throughout the year.

An international endeavour is being made to get blast furnace owners to supply pig-iron to analysis. The Government and other public bodies tie foundrymen down to various specifications, so it will be recognised that it is important to have pig-iron sold to analysis. In time we shall get it. America has succeeded, and some British iron makers at present will guarantee analysis within a point or two.

The Institute has also published a dictionary of technical terms used in foundry matters. This is very useful. Old foundrymen often come across words they do not quite understand, and its value cannot be estimated. It has also furnished a report on foundry apprenticeship schemes. The idea of to-day seems to be to get juniors in the foundry to pick up what they can, but little systematic teaching is in operation.

Institute of British Foundrymen representatives have read Papers before the American Foundrymen's Association and the French Foundrymen's Association, and thus has something of an international character.

A couple of years ago the President (Mr. Oliver Stubbs) and Mr. T. Firth, of Sheffield, visited America on Institute business, and so initiated the now established system of international conferences. The same year Mr. F. J. Cook, another past-president, read the first international exchange Paper in America before the American Foundrymen's Association. Last year about 60 or 70 Americans came to England and were accompanied to the Paris Congress by more than 100 British foundrymen.

The Institute inaugurated the British Cast Iron Research Association, the Government allowing their findings to be a basis.

Through the Privy Council, His Majesty has granted it a Royal Charter, having which it is unrecognised as an educational body. There are only about seven or eight similar Associations in Great Britain which hold a Royal Charter. It is something for foundrymen and their Institute to be proud of.

The Institute has members throughout the world. Canada, Australia, South Africa, India, the U.S.A., France, Belgium, Switzerland, etc., are all represented. Many of its Papers appear in the American Technical Press, and are translated into foreign languages.

He then called upon Mr. McClelland to read his Paper. "Warping and Shrinkage in Iron Castings."

MR. MCCLELLAND prefaced his remarks by stating he had taken the responsibility of lecturing upon himself, because he was a little afraid his efforts would not be as successful as they appeared to have been in getting together a satisfactory audience, and he did not want to ask a "Star" lecturer to address a poor audience.

He was gratified at the number present, and from the applications he had had for tickets he did not think the hall would have been large enough had all been able to be present. There were many applications from Swansea, Llanelly and Ebbw Vale. It was clear the people in South Wales were interested, and if a sustained effort was made we should be able to have a very satisfactory branch.

It was said here, in this hall, during the time of the Mining Exhibition at Cardiff, that South Wales stood in a peculiar position commercially. There did not seem to be the extensive field in Wales that there was in other parts of the world. If one removed the coal, tinplate, and slate industries from Wales there would be very little else left.

Those industries which were thriving in other parts were not to be found, and apparently the responsibility did not rest with either the technical or practical brains, and if somebody with sufficient capital came along, there would soon be found plenty to manufacture.

He was speaking purely as a moulder, and he considered the man who attempted to be a capable moulder required to be highly intellectual and physically fit. The foundry was no place for the imbecile or delicate man. They had to have intelligence to cope with elements all of which should not be thrown on the shoulders of the foundrymen.

Warping and Shrinkage in Iron Castings.

There are various shrinkages in different classes of metals foundrymen have to deal with. For example, steel and iron do not shrink alike, and bronze does not shrink like either, and from these troubles a great many mistakes occur from time to time. Many of the moulder's troubles could be removed if greater care was taken in other branches of the industry.

The draughtsman should consider the question of shrinkage as well as strength. He has to work out the stress materials will stand, and the troubles in the foundry are very often overlooked.

One often encounters patterns which are uneven in thickness. This throws a responsibility upon the foundryman of determining what influence the shrinkage will have upon the warping by the unequal proportions of the casting. In the ordinary pulley, for instance, the rim, being very thin, and the boss, usually being much heavier in proportion, naturally the rim solidifies and cools off more quickly than the heavier portions contained in the boss, with the result that the boss has only commenced to shrink when the rim has completed, or almost completed its contraction. Most foundrymen know it is customary to put bent arms in pulleys to allow for a little spring when shrinking. This method is often very successful, and even if the castings go through the storeroom and machine shop without showing any signs of fracture, there still remains a strain on the arms of the pulley which is never released until fracture takes place.

With regard to heavy flywheels, there is sometimes the opposite effect, the rim being heavier than the boss and arms, the arms and boss cool before the rim, and in resisting the contraction of the rim which follows there is a compression set against the arms. This compression strain is never released until fracture takes place, and occasions have been known where wheels have withstood machining, fitting on engines and gone through all

the preliminary tests, but eventually have burst, causing very serious mishaps.

In connection with this part of the subject, it is thought that relief could be given to the foundryman if more attention was paid in the drawing office to the proper distribution of the materials being used.

Cast iron does not always shrink the same. In this country it is 1-10 in. to the foot. In America ⅛ in. to the foot. Either is right, and probably both are wrong. Once the speaker had the unique experience of having some cast iron which did not shrink at all. He was making locomotive cylinders, and put in the usual core for forming the bore of the cylinder, and naturally did not anticipate anything unusual happening. When this casting was set up in the lathe, they found there was no material to come out, and the bore was exactly the same size as it should be when machined. He was accused of using the wrong core box, but when the core box and the casting were compared, they measured alike.

In Falkirk district they use Middlesbrough iron for making baths, kitchen range work, rain-water pipes, etc., for which it was necessary to have a class of iron which would be fluid in a molten state and give a minimum amount of trouble in shrinking. On the other hand, if the foundryman requires the best qualities of iron suitable for heavy machinery and other classes of heavy work, they generally recommend the use of Scotch iron.

A little while ago the speaker attended a function where there was a pig-iron manufacturer. This gentleman, called upon to respond to a toast, said: "I am employing a large number of hands turning out a product which all foundry people must use. Up to now I have never supplied to analysis, have never been asked for analysis, and if you ask me to supply to analysis, I will try to get out of it," and as this has appeared in print, it is surely not out of place to repeat it.

If it were possible to get all foundrymen organised in an Institute of this character, whereby the continuation of the study of the problems which they have to solve are associated with a constant exchange of opinion in conjunction with the scientific side of the business, it would be possible to arrive at a solution of many of our troubles.

Before stone was as common as it is to-day, the iron casting shown in Fig. 1 was often used for making window lintels and sills. Strange to say, the sill casting for the bottom of the window, although uniform in thickness, was very difficult to make straight, and it involved a very careful arrangement of runners to get an equal distribution of temperature all over the casting necessary to make an unwarped casting.

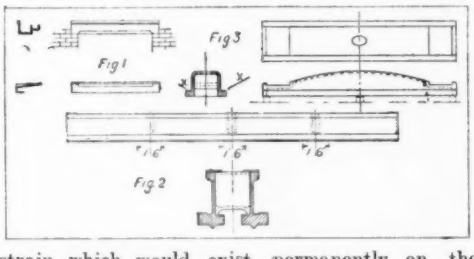
At the top left-hand corner of Fig. 1 is shown a different cause of trouble, there being a beading which runs the full length of the casting, making the metal heavier on the front edge. This introduces a tendency to create an unequal rate of cooling, and so a warping of the casting. Probably these complaints have had a good deal to do with the almost entire abolition of the use of this type of casting.

A Lathe Bed Difficulty.

Fig. 3 represents a section of a lathe bed of a heavy type, the total length of which was 38 ft. It was made in two pieces, each being about 19 ft. long. It will be seen from the sectional view that in order to get the strength required the slide portion is made considerably heavier than the other part, and it is difficult for a foundryman to understand why it should be impossible, where strength is required, to give a more equal distribution. Naturally a lathe bed must be rigid, as well as strong, and if a little less metal were put in the slides and a little more in the side part of the bed, it is difficult to imagine that it would make it any weaker or that it would diminish the utility of the casting. As it is shown, the sides would naturally cool down before the heavier metal shown in the slide portion and thus cause a tendency for spongy spots. When such a casting is received into the machine shop, the foundryman will be told that they have used a poor quality metal. The best qualities of iron are often more spongy than inferior iron. It is therefore incumbent upon the moulder to find some remedy to render the metal solid by putting large feeders to feed the heavy portion of the castings whilst the metal is solidifying. Having accomplished the feeding of the casting and rendering it solid, he is still up against another problem. The casting being 19 ft. long and the heavy slide portion running the full length, it will be found that the lighter part of the casting has cooled down and almost completed its contracting before the heavier parts have hardly commenced to contract. This means that as the heavy parts contract and the cooler part offers a resistance against contracting, warping takes place, pulling the ends down, or the centre rising as much as 1¼ in.

With this class of casting one manager, in trying to overcome the warping trouble, used to strip off the moulding boxes and get the casting out of the sand immediately it had set sufficiently, and place the ends on blocks, and some heavy weights on the centre. By this method he thought he could get them straight, but never succeeded in so doing. Eventually it was found they had to thicken up the pattern and leave on sufficient material for machining off and bring them straight in the machine shop.

The method which the speaker adopted was to dig three holes under the casting and bare the heavy parts of the bedplate, allowing a current of air to come in contact at the three points marked, 1 ft. 6 ins. wide on the slide, and allow the casting to remain in the sand for two days, so that it could cool down uniformly. By this method a definitely straight casting was produced, and warping was not only eliminated, but also the



strain which would exist permanently on the thinner portions of the castings if there had not been that equal shrinkage of all parts of the casting.

How a Planing Machine Rail was Handled.

Fig. 3 shows a cross rail for a planing machine and boring mill. This is a casting with a heavy slide-portion running across the machine for carrying the tool box, and having a box-shaped back. On the receipt of an urgent order for a dozen such castings, and in our anxiety to get out the order quickly, we discovered the castings had warped as much as ⅜ in., and when delivered they were condemned. A request was made to the purchaser for permission to straighten them, to which he agreed providing they were not fractured.

The castings were set up, resting on two end-blocks, and a block was put under the centre ⅜ in. clear of the casting. A 2-ton weight was put on the centre, and then a good hot fire was made entirely around the centre of the casting. As the casting got to a glowing heat the centre came down on to the centre block, and whilst in this position two core plates were fixed up as shown at XX, the fire was withdrawn from underneath the casting, and still kept burning around the top part of the casting until the heavy portion had gone black, when the fire was allowed to die down gradually, thus keeping a more or less equal temperature as the casting became cool, and by this method the foundry were able to save the whole twelve castings.

DISCUSSION.

MR. HERD, after thanking the lecturer, said the author had found some iron which would not shrink. He had never encountered it, but probably a hard core coming in contact with cast iron may account for it. Tests he had taken over a considerable period by making a 12-in. bar, ½-in. section, cast between yokes, should provide a good guide for shrinkage, and although soft iron does not shrink like hard iron, he had never met with any that did not shrink at all.

With regard to the question there had recently been a great deal of talk about the supply of pig-iron to analysis, and he felt it would be a great help. America has it to a large extent, but it had not solved all their problems. Sometimes it puzzled more than it helped.

He always overcame the difficulties of lathe beds in the same manner as that Mr. McClelland adopted with the spinning machine casting. The camber was made in the pattern and by this method; the castings usually were fairly straight.

MR. FLETCHER, speaking with regard to cast iron which had not shrunk, said it was perhaps highly phosphoric, and a high percentage of phosphorus causes expansion on cooling.

MR. HILLS said he was very pleased to think there was a possibility of having a Branch of the Institute of British Foundrymen in Cardiff. Not only would foundrymen get useful information, but good fellowship. He agreed with Mr. McClelland it required an amount of brainwork to ensure a good casting. He had made girders 20 to 25 ft. long, weighing 7 tons, which warped very badly, and the method adopted for making them straight was the use of a number of men hammering them as quickly as possible.

MR. HOWE asked the lecturer if altering the grade of iron would make any difference to warping, as it is known hard iron has a great shrinkage and soft iron less.

The Author's Reply.

MR. MCCLELLAND said the criticism had not been very severe, and he wished to emphasise the point raised by Mr. Herd that foundrymen do not always learn the most from the lecturer, but from the discussion which follows.

He went to the United States when 22, and thought he had learnt a trade, but he found other people knew things as well as the British.

In America Salisbury iron was generally used for chilled car wheels. Railway carriage and truck wheels were always made in cast iron. Salisbury iron was more malleable than any other kind of cast iron he had encountered. To ensure giving satisfaction he used Salisbury iron, and it was no imagination to say that it did not shrink. Of course, after they had put a liner in the core box and made the bore smaller, it left sufficient metal for machining.

With regard to the question of blacking, a 20-in. dia. bore would require a lot of blacking, and the claywash would need to be very thick to get sufficient on the core to make up for the shrinkage, but in America it is not customary to use blacking. They used plumbago, or what they usually call silver lead, which is neither mixed up with core gum or claywash, but is used with water only.

It had already been said high phosphorus in iron reduced the shrinkage, and naturally a low phosphorus would increase the shrinkage, which proves what he had already stated, that iron does not always shrink the same. This is illustrated by firebars.

Peaning a casting to make it straight is not a new idea, but it is not always satisfactory. One cannot possibly remove the strain existing before peaning, and there will still remain the strain of unequal contraction. This defect would not be removed by any hammering process.

To camber a pattern may, to a certain extent, prove satisfactory in turning out a straight casting, but to say the least, it is not altogether satisfactory, because it always has the effect of creating a strain on the texture of the material by one portion pulling against the other, and this strain would never be relieved whilst the casting remains whole. By any method of equal cooling, it is very much better than cambering, because it entirely obliterates any possibility of unequal strain, and the casting is in a much better condition, and free from any prospects of mishap.

In connection with stove work of course the foundryman is up against a different problem, the castings being so light they cool much quicker, and it is necessary to use an iron, which is reasonably high in phosphorus to reduce shrinkage to a minimum, but even with the best of iron for this class of work, when introducing a new stove, some of the parts of the stove have to have several patterns made before they can get at the right camber to give satisfactory results. The usual method being to build up the pattern with sheet lead on blocks or plaster of paris moulds until such times as they get satisfactory results.

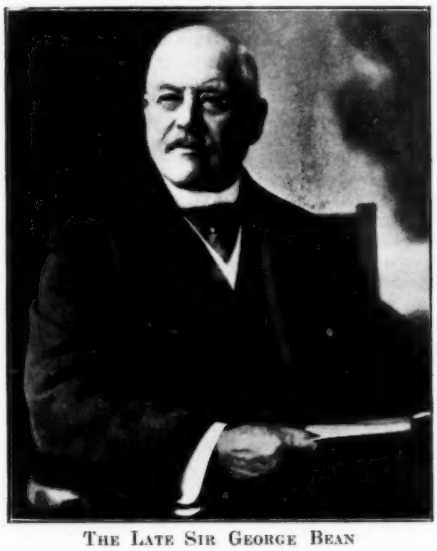
With pulleys, it is usual to take the core out of the hub until they allow the atmosphere to get at the heaviest portion of the pulley, thus increasing the cooling to keep pace with the rim, but on flywheels for gas engines and the like, it is sometimes necessary to resort to the opposite and uncover the rim and expose it to the air in order to get equal cooling with the arms and the boss.

The Late Sir George Bean, J.P.

The foundry industry has suffered another loss in the death of Sir George Bean, J.P., which occurred at his Dudley residence, Oakham Lodge, in the early morning of January 23. The funeral was at the Dudley Parish Church on Saturday, the 26th.

Sir George—who was 68 years old—was the Chairman of A. Harper, Sons & Bean, Limited, the manufacturers of the cars bearing his name, and, in conjunction with his son, Mr. J. H. Bean, he developed this very old-established business into one of the most prominent concerns in the country. During the war the Bean organisation did much to speed up the supplies of munitions to the fighting arms, and in recognition of this and his many public services, the honour of Knighthood was conferred upon him by the King in 1919.

Sir George was also Chairman of Messrs. Allen Everitt & Sons, Limited, of Smethwick, and a Director of Messrs. Manning, Wardle & Company,



THE LATE SIR GEORGE BEAN

Limited, of Leeds, and in addition to his many commercial and industrial activities occupied himself with public affairs to an extent equalled by few.

He was an Alderman of the Borough of Dudley, and was three times Mayor, in 1908-9, 1911-12 and 1912-13. He was Chairman of the local Housing and Finance Committees, Chairman of the Overseers, the Mayor's Auditor, a Justice of the Peace (Borough and County), and a member of the Education, Public Works and General Purposes, Streets, Tramways and Lighting, Special County Council and Public Libraries Committees.

Sir George was also a member of the Council of the Training College, a Governor of the Dudley Educational Foundation, a Trustee of the R.U. Dudley Homes for Necessitous Gentlefolk, a Trustee of Baylies' and Parsons' Charities, and Chairman of the Birmingham and Midland Counties Nerve Hospital. Dudley and district owe very much to Sir George Bean. On two occasions Sir George had the honour of welcoming Royalty to his works: H.R.H. the Duke of Connaught visited them shortly after the war, and H.R.H. the Prince of Wales in June of last year.

Discussion on Mr. Bartlett's Paper, "A Day at the Cupola."*

MR. H. B. WEEKS, F.I.C. (Chairman, British Cast Iron Research Association), who, with many other visitors present, was warmly welcomed by the Branch-President, opened the discussion. In expressing thanks to the Institute for the opportunity of being present that evening, he said that had it not been for the Institute of British Foundrymen the chances were that there would have been no British Cast Iron Research Association. He could not speak too highly of the interest displayed by the members of the Institute in the formation of the Association, and they could take it from him that the Association was really doing excellent work. Research work, of course, took a considerable time to develop, and it would be some time before results which were likely to be of any use in the foundry were brought to light, but the Association had some fundamental researches in hand, which it was hoped would have a tendency, at all events, to elevate the foundry history and put it on a level with other engineering industries. Up to a few years ago there was no branch of engineering that had been so sadly neglected as the foundry industry; the reason, possibly, was not far to seek. In our younger days it was most difficult to get anybody at all to go into the foundry as an apprentice. As a matter of fact, only a few years ago, at Barrow, where they charged a small premium for apprentices in the various trades, it was impossible to get anybody to go into the foundry as an apprentice if his father could or would afford to pay the fees. The consequence was that the foundries got the very worst class of boy in the district, and it was from such raw material that the personnel of one of the most important of engineering industries was built up at the present time. It was hoped to alter that state of affairs, and, in conjunction with education authorities, to educate boys generally in foundry work, so that the industry would have intelligent and educated men in charge, as was the case in other engineering industries. Speaking with regard to the Paper which had been read, Mr. Weeks complimented Mr. Bartlett on the clearness with which he had put the case. So far as he himself was concerned, the Paper did not lend itself to discussion, because it simply described Mr. Bartlett's own practice. Probably many of the members present would have different views on many of the points raised, but he himself was not finding any fault with Mr. Bartlett if he found that the practice he had described gave him the best results; that was, after all, what was required. He expressed the great pleasure he felt at being present, and congratulated the Institute upon the excellent work it was doing and the interest displayed in foundry matters generally, as was evidenced by the large number of members present.

MR. G. HALL asked why did Mr. Bartlett use chalk instead of limestone, whereas other foundrymen used limestone instead of chalk? Apparently the only difference was that one bought limestone, whereas one could in some districts get chalk for nothing.

MR. GIBBS, speaking with regard to the filling in of the tapping hole, said Mr. Bartlett had mentioned that that was done from the outside. His (Mr. Gibbs) practice in connection with the large furnaces at Stratford—which, by the way, were not so large as mentioned by Mr. Bartlett—was first to stop the hole from the inside, and then to finish stopping it from the outside. He had found that if this was not done, there was a tendency to get what was called a "hard hole," owing to the metal accumulating in the scooped-out portion on the inside. Mr. Bartlett stated that before the blast was put on, the tuyeres were closed. That was altogether contrary to his own practice. He made a practice of opening the tuyere holes, so that there was no real opposition or back pressure to the blast when it first came on, and gradually shut one tuyere after the other, so that the blast came on steadily. Again, the lecturer had made two statements which, he believed, could not be reconciled one with the other. Mr. Bartlett had started with a 1-ton tap. The well of the furnace held one ton, and then the tapping hole was kept open until the next tap, of 10 tons, had been run. Immediately after that he had said that after 5 tons had been melted he opened the slag hole. He (Mr. Gibbs) wanted to know the effect of the opening of the slag hole on the rate of melting. It meant a loss of air or blast, and in his own practice it had been proved conclusively that they could not melt at anything approaching the former rate with the slag hole open. He asked whether Mr. Bartlett obtained slag before he had completed the 10-ton tap. Mr. Gibbs hardly agreed with the point of view that if the limestone melted we were likely to get a blocked edge, or what was termed a "cork," in the hole. Another point which he did not think was good practice was, after the ladle was full, to stop the blast while getting another ladle under the spout. It seemed to him that if that practice had to be adopted in Mr. Bartlett's foundry, the system of inside transportation wanted speeding up. He hoped Mr. Bartlett would accept these criticisms in the manner in which they were intended; apart from those criticisms, he congratulated Mr. Bartlett upon his most able Paper, dealing, as it did, with a subject which very few people cared to tackle.

Separation of Charges.

He also congratulated Mr. Bartlett upon being one of his adherents on the question of the separation of charges. Mr. Faulkner had challenged him (Mr. Gibbs), through THE FOUNDRY TRADE JOURNAL, on this question; nothing would give him greater pleasure, if he were in an iron foundry to-day, to carry out the practical tests required by Mr. Faulkner, just to prove that he could separate charges on the basis suggested by the lecturer, but, unfortunately, he had been transferred to a brass foundry.

MR. C. CLEAVER said that as Mr. Bartlett's practice was satisfactory to himself, he did not think one could do any better than he was doing, but it certainly differed from some practice. He asked Mr. Bartlett if he would say what was the function of the two rows of tuyeres. With regard to the chalk *v.* limestone problem, he would like to know if Mr. Bartlett had any figures on which he calculated his charges of chalk, and what difference he had found in the actual sulphur content of his iron compared with his calculations.

Open *versus* Closed Tap Holes on Starting.

MR. G. C. PIERCE asked Mr. Bartlett how he would get the tapered tapping hole from the inside of the furnace if he had no back door. With regard to botting-up until the metal started to flow, although he had seen several cupolas worked, he did not think he had ever seen the hole botted up until the metal began to flow. However, he had listened to Mr. Bartlett's explanation, and it did appear to be logical, but it was rather strange. He believed the common practice was to wait until the metal had started to flow before botting-up. He asked Mr. Bartlett to give the capacity of his furnace per hour, because he wanted to be able to work out a ratio from the size of the tapping hole. He had understood Mr. Bartlett to say that he had a 1-in. tapping hole, and wanted to know whether he would expect the hole to be of the same ratio if a smaller quantity of iron were wanted per hour than the quantity actually melted in his furnace. With regard to chalk, he realised why Mr. Bartlett used it; it was simply, as had been said, that he obtained it for nothing, but he wondered if Mr. Bartlett would give his opinion as to the relative merits of chalk and limestone—how much chalk he would use as compared with the amount of limestone he would use ordinarily.

* This Paper appeared in our last issue.

MR. E. H. BROWN said there were one or two points he wished to raise. First, with regard to the 21-cwt. charges; with a 3-ft. 6-in. cupola, did Mr. Bartlett consider that a 21-cwt. charge was more economical than, say, a 30-cwt. charge, or did it give him better mixing, or exactly what was his idea in keeping the charge so low in so big a cupola? Again, Mr. Bartlett had said that he believed in fluxing right from the very first charge, on the principle that if the later charges required fluxing, so did the first. That was one side of the question, but, on the other hand, when the first charges of metal were put in, they had practically a new coke, and the ash from that coke was not produced by the first few charges of metal; therefore, he preferred to see that no flux was added with the first few charges.

Chalk as a Cupola Flux.

With regard to the ratio of flux to coke and iron, he would be pleased if Mr. Bartlett would give some idea of the actual proportion of calcium carbonate in his chalk, and the proportion of water; he was of opinion that at least 50 per cent. of the weight of it was water. As to the choking of the volume of air, he personally, after a series of chemical tests, had come to the conclusion that any alteration in the volume of air passing through the cupola did alter the actual chemical composition of the metal going down. The effect of retarding the air blast in the cupola was to alter the conditions inside, which, afterwards, did not revert to the original state. Mr. Bartlett had admitted that the iron was considerably cooler in that period. After that, therefore, it became necessary to raise the temperature inside the cupola, because it had cooled down somewhat, and that, if nothing else, altered the absorption of sulphur from the coke, and also the proportion of silicon and manganese which was burnt out.

As to the loss of temperature in a metal through keeping it in the well of the cupola, did that occur after the well had been filled up two or three times? Was it not better to keep the charge in the well of the cupola provided the cupola had a receiver, than to leave a small quantity of metal lying at the bottom of a big ladle exposed to a large cooling surface? Finally, Mr. Brown advocated the practice of alternating the tuyeres, *i.e.*, having sufficient tuyeres on a cupola so that, after every quarter or half an hour, one could alternate with them, working one set and closing the others, so that the face of the tuyeres which had been receiving the cold air had time to heat up again, and the slag had time to melt.

Chromite Bricks.

THE BRANCH-PRESIDENT said he had given a great deal of thought to the Paper which Mr. A. A. Liardet had read before the Branch in November last, on mechanical charging, and recently he had seen a very large installation—a 12-ton-an-hour cupola—in the Newcastle area, which was mechanically charged. The only time that any damage was done to the brickwork inside the cupola was during the initial filling up. He had suggested to the owner of that furnace that he should instal chromite bricks which, he believed, would meet the difficulty very well. They were neutral in character, and almost as strong as cast iron. Continuing, the Branch-President said he was afraid he would never agree with Mr. Gibbs that it was possible to separate charges in the cupola without unduly interposing heavy coke charges. Dealing with the utilisation of chalk or limestone, he said he had never been able to fathom the reason, apart from its powdery nature or cost, why lime itself should not be used. After all, it needed a considerable number of heat units to convert limestone to lime, which had to be provided by the coke charge in the furnace. He presumed that foundrymen would object to the powdery character of lime. Mr. Brown had made reference to the uselessness of flux for the first two or three charges, because of the absence of ash. Personally, he did not attach any importance to that point. He did not think the ash was such an important point as the amount of sand and dirt sticking to the surface of the pig-iron and scrap. There was one question he would like to ask Mr. Bartlett, namely, what was the percentage of lime in his cupola slags? It was considered by one of our foremost experts that cupola slag should carry 35 per cent. of lime, although most foundrymen would consider that rather heavy.

Open Tap-hole Advocated.

MR. R. J. SHAW suggested to Mr. Bartlett that it would be of interest to some of the members if he said how he would deal with a cupola on a day when it was not working so well, when there was a hard hole, and the bottom leaked and the tuyeres blocked up. It was all very nice when things were going well, but it would be useful to know how to deal with these things when they went wrong. There was one thing he could not quite follow. Mr. Bartlett had advocated botting-up the tap-hole at the beginning of the blow, for fear of the flux matter coming down. He could not quite see how that happened. He worked with an open tap-hole, and ran a couple of cwts. through it; it was as well to be on the safe side in these matters, and he did it mainly to dry and harden the hole. He had one cupola which he had bricked up to a smaller diameter, for use when business was slack. Normally the diameter was 36 in., but the extra row of bricks in it made it smaller, about 27 in. The brick lining was therefore about 14 in. thick, and they arranged a large recess at the back of the tap-hole in order to keep the tap-hole short and prevent the cold metal gathering and solidifying. He gathered that in Mr. Bartlett's cupola there was a small recess round the tap-hole, and this made it rather dangerous in the event of a hard tap-hole.

Separation of Charges.

MR. J. W. GARDOM, speaking of the separation of charges, referred to some experiments he had carried out recently similarly to those which had been carried out by Moldenke—by putting cast-iron bars in various parts of the furnace lining before starting the blow, and then, after the blow, seeing how much had melted. He had a small cupola of 30 in. diameter, and during the cast he had found that the melting zone was nearly 3 ft. above the tuyere zone. He was melting a mixture containing 75 per cent. steel, and had used a very heavy coke charge between the charges of metal. That was convincing proof that one could not separate charges. The way in which he looked at the air supply into the cupola was that if there was sufficient air, the air would go right into the centre of the cupola, and up the centre, but if there were not sufficient force then we got a melting cone. If at any time we altered the pressure the cone must be higher up. In Mr. Bartlett's practice he would surely alter the size of the cone, and then he would surely alter his melting range, which would be higher up the furnace. Therefore, he did not think he would separate charges. With regard to adding the flux on the first charge, theoretically he believed the flux was useless until there was some silica there.

MR. H. COLE ESTEP, as the editor of a foundry journal, appreciated very much the service which Mr. Bartlett had rendered in reading this very practical Paper. It was surprising, he said, what a great number of letters his publication received, continually asking, "How do you put the sand bottom in the cupola?" "How do you make a tap-hole?" and so on. This showed that, although they had thought that Mr. Bartlett was going to read a Paper on something they knew all about, they knew very little about it actually, although they were carrying out the operations every day. There must be many thousands of foundrymen who were still very much in the dark about these apparently very simple matters. Mention had been made in the Paper about the blast entering the box tangentially, so that the air would run round in a spiral fashion and go through the tuyeres. It seemed to him, from observations he had made in both American and British foundries, that that was unnecessary. It certainly cost a little more—although perhaps not enough to worry about—to fit up a cupola in this way. After all, if the pipe went straight in, the air split and went round on both sides, and the tuyeres at the back did not know whether the air was brought in tangentially or straight. Mr.

Bartlett had also mentioned the necessity for having the spout of the tap-hole thoroughly dry. That raised the question of whether the blast should be turned on with the tap-hole closed or open, and on the other side of the Atlantic the preponderance of opinion was that the open tap-hole was preferable, if for no other reason that we were sure that it creates perfectly dry conditions for bringing out the iron. He doubted very much if we could get sufficient drying of the spout of the tap-hole by the method described by Mr. Bartlett, and he would not be surprised if Mr. Bartlett got merely a thin skin dry. Some foundrymen built a wood fire all along the spout and thought they were getting it dry. The way to be sure about it was to use a torch having a flame temperature of about 2,000 deg. Fah.

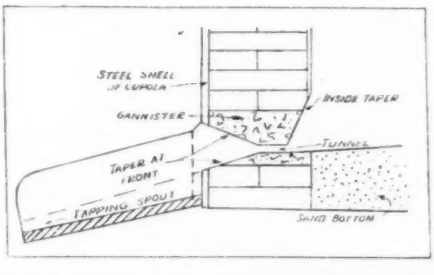
Lead in Tuyere Belts.

MR. H. O. SLATER, speaking with regard to the taper at the back of the hole and also in the front of the hole, said there was no metal that would teach a man the value of a good, dry tap-hole than malleable iron. When foundrymen could not tap out the slag through the slag notch hole, and they entered the belt, it was desirable to have four 2-in. holes drilled in the bottom of the belt, stopped up with lead so that instead of burning the belt away or even settling there, melted the lead and so through to the floor. With regard to ramming out the bottom of a furnace, on one occasion when starting a furnace he had found, after it had been blowing for about an hour, that the metal was coming through the bottom of the furnace instead of through the tap-hole. The furnaceman said he had rammed the bottom as hard as possible, and had even used a 7-lb. hammer. Naturally, said Mr. Slater, ramming the bottom of a furnace was just the same as ramming the bottom of a mould, and it was quite possible that the bottom of the furnace would scab in the same way as the bottom of a mould. There was no outlet for steam, etc.

THE AUTHOR'S REPLY.

MR. BARTLETT, replying to the discussion, said that the question that seemed to trouble a good many was why he had used chalk instead of limestone. The guess that several speakers had made was quite right; he got it for nothing, or at least for the digging. He had used limestone, more or less as an experiment, to see whether it would pay, or whether the results were better than with chalk; but when the commercial aspect was considered, and he remembered that he was operating in a competitive world, he had come to the conclusion that limestone offered no advantages over chalk when the latter was obtained for nothing. As to quantity, he used 1 cwt. to each charge, which was 21 cwt., but when using limestone he used only 40 lbs. per charge. Whether or not he was right in so doing he did not know.

Reference had been made by Mr. Gibbs to the fact that the tap-hole was filled in from the outside, and he had thought it could not be done. The tunnel of the tap-hole in this case was only 2 in. long. That was filled with sand quite easily from the outside, and the taper on the front was rammed quite hard in front of that. He illustrated the filling in by means of the following sketch:—



The closing of the tuyeres when the blast was put on was also referred to by Mr. Gibbs, who had said that he generally put the blast on and then closed the tuyeres gradually. Again, all he could say was that he was just giving his own practice. He had always closed all the tuyeres before the blast was put on, taking it for granted that the blast was required to get the intense heat which had been spoken of and to get perfect combustion.

As to the opening of the slag hole, he (Mr. Bartlett) had said that his experience with the cupola under consideration was such that it was considered advisable to open the slag-hole when he had melted 5 tons. It was found, with the method of fluxing adopted, that sufficient slag accumulated during that period to float up to that height, and if he did not tap the slag-hole at that time—after a period of somewhere about 50 minutes—the slag would be getting into the tuyeres.

Difficulty of Charge Separation.

With regard to the blast being eased in order to put in the second ladle after the first one was out, the point was that he oft-times put a surcharge of the one mixture and a surcharge of the following mixture between the blank charges to help him to be sure that he was getting the perfect mixture desired. That was because of the possibility and the probability of the varying mixtures getting slightly mixed. When he put 10 tons into a large ladle under the cupola a hole had to be dug to put it in. Of course, in his Paper he was only dealing with one particular day, and had records of it. The next ladle only held 1 ton, and the hole had to be filled up. If the cupola had been blown at the full rate he would have had the metal in the tuyeres, so that, under the circumstances, the blast had to be eased in order to get the hole filled up so as to get the smaller ladle under the cupola.

Replying to Mr. Cleaver's question as to why there were two rows of tuyeres, Mr. Bartlett said he had carried out a tremendous number of experiments with this particular cupola. He had knocked off one row of tuyeres and tried to work with the remaining row. It was not possible, at too high a pressure, to get the volume of air down, and in his experiments he had obtained such a tremendously high pressure that he did not get such a good result. Therefore, he went back to the two rows of tuyeres.

In answer to Mr. Pierce, who wanted to know how a man would put the taper in the hole at the back without having a back door, Mr. Bartlett said that if there were a drop bottom and no back door the man could get in at the bottom. He (Mr. Bartlett) contended that it was essential to have the taper inside the cupola as well as the taper on the outside.

Open Tap-hole Practice.

Several members had spoken about the metal flowing from the furnace before botting. He had given his practice and the reasons for it. These cupolas had been going for something like 30 years, and he was used to it. The very first furnaceman at his foundry had had an idea that the right way to do it was to blow the metal through the hole before botting in, then bot in and let the metal accumulate. He (Mr. Bartlett) had seen more hard tap-holes in the early days than he had seen since he had stopped that. The main point was to get the hole dry. There was no difficulty in drying.

Mr. Pierce had also asked why there was an inch-hole in the tunnel. That was the ratio of the amount melted—the cupola in question melted about 6 tons per hour on an average. If less metal were melted the hole would be smaller, and if the cupola were larger, and a larger quantity of metal were melted, the hole would be larger.

In reply to Mr. Brown as to the 21-cwt. charges, Mr. Bartlett said he considered them more economical than larger charges. He took it that a 21-cwt. charge was the right ratio for that size of cupola. For larger cupolas he used a larger charge, going up to 24 cwts., and with a 2-ft. 6-in. cupola he used a 10-cwt. charge. The size of the cupola decided the economic charge.

As to adding a flux with the first charge, there was sand on the pig-iron and the scrap, and he considered that that required fluxing just as much as the later charges.

Mr. Bartlett was convinced that there was a

greater loss of heat in the metal lying in the well than in a ladle. He had tested that with a pyrometer, and had found that the metal in the ladle kept hot longer than that left in the well of the furnace. In reply to the Branch-President, he said he had no knowledge of the lime content of the slag.

Mr. Bartlett, continuing, said he understood that Mr. Gardom, in referring to the separation of charges, had said that he had tested the melting zone of a cupola and had found it to be 3 ft., and had contended that he could not separate the charges because the second charge would be in the melting zone before the first was out. He (Mr. Bartlett) did not think one could separate 1 ton of metal from another 1 ton of metal and be sure that the analysis of the first ton would be what was expected, judging from the charge, and even with 10 tons or larger quantities it was found advisable to have a surcharge for the first and second in order to be sure of getting the metal right for the two charges.

Replying to Mr. Cole-Estep with regard to the entry of the air, he said it was found that the best results were obtained, after many experiments, by putting the air in at a tangent. His contention was that by this means he obtained a softer blast. Whether that was just an idea or whether there was something in it he would not be quite sure. It was merely a fancy, and he had no definite proof that there was any improvement.

As to Mr. Slater's point of putting lead into the wind belt, he would say, keep the metal out of the wind belt and then there was no need to have any lead in it. He knew it was the practice with the whiting cupola to put lead discs into the bottom of the wind belt so that if metal or slag got in there it melted the lead; but it stopped the work for the rest of the day or until the lead could be replaced, and that was the unfortunate part of it. The remedy was to have proper practice.

Reference had also been made by Mr. Slater about the difficulty of having a set tap-hole. Certainly one could drive another tap-hole over the bottom one. But what happened? There was a well of metal at the bottom of the furnace until the end of the day, and the way to get it out was to drop the bottom. Unfortunately, however, everybody near ran the risk of being burnt. The best thing to do was to apply preventive medicine rather than curative.

Vote of Thanks.

MR. H. G. SOMMERFIELD (Branch. Hon. Secretary), proposing a vote of thanks to Mr. Bartlett, remarked that the lecturer could confidently take the splendid attendance as a signal compliment. The lecturer must feel particularly gratified to know that he—a London Branch member—had addressed a meeting at which there had been the best attendance so far this session. As Hon. Branch Secretary, it was most gratifying to know there were such men in the Branch who would respond, with such very little persuasion, to an invitation to give the members the benefit of their useful experience.

MR. WESLEY LAMBERT, in seconding the vote of thanks, said that he wished to express the pleasure he had had in listening to Mr. Bartlett. When the title of Mr. Bartlett's Paper was first announced to be "A Day at the Cupola" he had suggested to that gentleman that he should describe in detail the day's working at the cupola right from the beginning, as he (Mr. Lambert) did not know of any text-book dealing with cupola practice which described in detail the preliminary work of preparing the cupola, the lighting up and preliminary manipulation generally. He thought such information would be of interest, not only to the younger members, but to the Branch members generally. Mr. Bartlett had covered this ground and also very much more, and had described his own practice apparently without any reservation. A number of minor operations and gadgets had been described, some of which, although not meeting with the approval of some of those members contributing to the discussion, were certainly interesting in connection with cupola practice.

The vote of thanks was accorded with acclamation.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

To the Editor of THE FOUNDRY TRADE JOURNAL.

First Cost, Best Cost.

SIR,—In the writer's experience many little problems have arisen similar to those which, it is taken for granted, have happened to hundreds of others who have to produce good, sound castings for highly-finished work.

Only too often the design of a pattern plays a very important part in the production of a satisfactory piece of work, for it is essential that uniform rate of cooling and the elimination of stresses set up by irregularity of pattern should receive the most careful consideration when possible from the drawing office and pattern room.

Usually the draughtsman is most painstaking. He delves into his calculations, and would sooner be placed upon the grill than be a fraction out in his work, but this is not a jot more desirable to the foundryman than a design which will produce a pattern as uniform in its thicknesses as may be consistent with his accurate detail.

In the case of the patternmaker, little scope is allowed him to assist the foundryman after the drawing has been made, but a careful craftsman may often introduce a core to lighten a particularly heavy section, or insert small brackets without danger of the resulting casting fouling any mechanism; or again, put in a fillet to strengthen a weak angle, and, in fact, assist in many ways to overcome an error which may not have been apparent when the drawing left the draughtsman's hands.

Times without number it is the foundry foreman's complaint that patterns sent down to him are the result of an organisation out of sympathy amongst its departments; very often a core print removed from one place on the pattern to another, without impairing its effect on the casting, will save labour, wasters, and lower the cost of production, especially so if the pattern is to be used for mass-production methods.

It is difficult to imagine why these three departments, drawing office, pattern room, and foundry, do not work together more unitedly on commencement of a new machine part, and especially so when these three departments are together in one factory.

Many jobs sent to the foundry to be made are of such an irregular shape and thickness as to require denseners to obtain the desired results, whilst others are found to require drawbacks, etc., both of which might have been quite unnecessary had the foundry manager or foreman been brought into consultation at the time the pattern was in process of erection.

A good all-round knowledge of the practical as well as the technical side of the moulder's craft is an essential, and this can only be improved by a sympathetic attitude towards the foundryman's task.

Again, in the writer's experience a piece of work executed in the pattern room has frequently been put together as a matter of extreme urgency, and the result of this has developed into a pattern which should have been made in halves, but has been sent to the foundry in one piece, involving "gaggers," deep joints, risks of a "waster" from "crushing," etc., etc.; or bosses, which would in the ordinary way of working have had pin attachment, etc., so as to work them loose, have been left secure; and, in fact, a whole lot of errors have had to be shouldered by the foundry, with chances that the job, when finished, has not given as much satisfaction as would have been the case had the pattern left the patternmaker's hands in such a manner as would have made "first costs, best costs."

This letter is not intended as a wail of prejudice or petty, fault-finding vapourings, but as a stimulus to effect a better understanding and a livelier co-operation between the drawing office, pattern room, and foundry.—Yours, etc.,

F. C.

Reinforced Cast Iron.

The manufacture of motor-car engine cylinders is one of the most difficult problems before the foundryman. To such a degree is this true that the general foundry has abandoned this business, leaving it to those shops which have specialised on the work. The internal arrangement of these cylinders is complicated; there are intricate passages and walls of unequal thickness, all of which it is essential to maintain accurately in their relative positions. These complications necessitate small cores of intricate shape, and it becomes exceedingly difficult to ensure the free escape of gas and to avoid porosity; of course, even the slightest porosity will lead to the rejection of the cylinder. The later designs of internal combustion engines have still further increased complications of this nature and have made the manufacturers' task even more difficult.

The motor-car makers adopt engines of ever-increasing output, running at higher speeds and having compressions of a degree undreamt of a few years ago. At the same time the demand is for lighter parts and castings: it is quite common to find thicknesses as small as 5-32 in. In order to produce a cylinder of sufficient strength for this severe service the founder now employs harder irons having a higher proportion of combined carbon. Unfortunately these irons are more

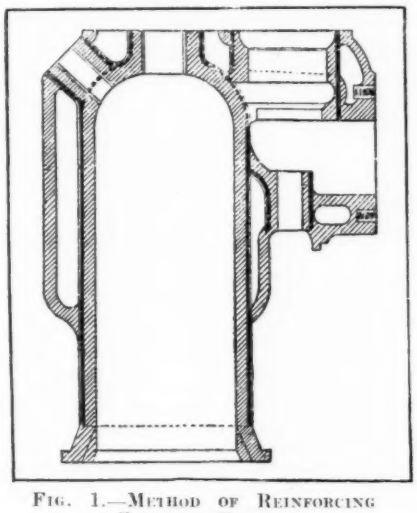


FIG. 1.—METHOD OF REINFORCING CYLINDER CASTINGS.

difficult to cast and are more liable to porosity. With cylinders of a particularly complicated design the rejections may rise to 90 per cent. of the castings, principally through porosity of the interior walls.

A Belgian foundry which for a long time has specialised in the casting of cylinders has established an interesting process which has given remarkable results. All the areas of a cylinder in which porosity usually appears—in the bore, on valve seats, etc.—are furnished with a casing of steel which is intimately bonded with the iron, so ensuring an impervious wall. These casings are made of dead mild steel sheet reduced to the requisite shape before being put into the mould. The casing is placed in the mould before the main core so that it becomes incorporated with the outer face of the cylinder wall. The thickness of the sheet composing the casing is determined by the thickness of the cylinder wall. The thickness of the sheet must be such that it becomes thoroughly bonded with the cast iron, but it must not be completely absorbed during the operation of casting.

The experience of eighteen months has demonstrated that this process has definitely eliminated porosity and has relieved the makers of cylinders from a nightmare. One manufacturer working this process had only two wasters from a batch of two hundred; even then, the cause of rejection was for faults other than porosity. But the principal interest of the process lies in the fact that soft, graphitic irons can be used, which are easily machinable and yet the casting will have the necessary strength to stand up to the severe duty imposed by a high-powered motor. The presence of the steel casing renders the mould partially metallic. The incoming iron is chilled by the metal lining with the result that, for a depth of about 3-32 in. the carbon is retained in the combined form and the structure of the metal is fine and dense. This forms the outer skin and gives the necessary strength, whilst the bore of the cylinder is of a highly graphitic iron which, when machined and finished, offers an ideal working surface for the piston.

This process is due to the researches of Mr. E. Meyer, director of the National Foundry at Contich; its use would appear to offer promise for the manufacture of containers for gas or liquids under pressure.

Personal.

MR. CHARLES SCHWAB, the American steel magnate, is on a tour in Europe.

SIR JAMES MCKECHNIE has resigned from the directorate of Vickers, Limited.

MR. F. A. GOVETT has been elected a director of the British Metal Corporation, Limited.

MR. ARTHUR DORMAN, managing director of Dorman, Long & Company, Limited, has left England for South Africa.

MR. W. B. PICKERING, a director of Hadfields, Limited, is on a visit to Australia in connection with the company's enterprises in that country.

SIR EUSTACE TENNYSON D'EYNCOURT, late Director of Naval Construction to the Admiralty, has been appointed a director of Sir W. G. Armstrong, Whitworth & Company, Limited.

MR. R. ARMSTRONG, assistant manager of the dock department of Palmer's Shipbuilding & Iron Company, Limited, at Jarrow, has been appointed manager of Cammell Laird's Admiralty works at Birkenhead.

MR. G. M. STEVENSON, of 136, Yardley Wood Road, Moseley, Birmingham, has ceased to represent T. W. Broadbent, Limited, of the Victoria Electrical Works, Huddersfield, and has established himself in business as an electrical contractor.

MR. P. G. WRIGHT, Leeds district manager for Stewarts & Lloyds, Limited, was the recipient of presentations from the directors of the company and his colleagues on the occasion of his completion of 50 years' service with the firm.

MR. W. HALLETT-CARPENTER has severed his connection with the Eyre Smelting Company, Limited, and has been appointed London manager for Capper Pass & Company, Limited, of Bristol, with offices at 16-17, Queen Anne's Chambers, S.W.1.

MR. F. WRIGHT, who has been for over thirty years with Palmer's Shipbuilding and Iron Company, Limited, and was recently engaged as traffic manager at Jarrow blast furnaces, has been appointed traffic manager at the Ebbw Vale Iron Works.

Wills.

SPENCER, T., engineer, of South Shields ...	£17,767
TOMPKINS, W. H., of Highgate Avenue, Walsall, Staffs, ironfounder	£7,643
NORKETT, ED., engineer, of Irwell Cottage, All Saints' Avenue, Maidenhead, Berks	£5,878
MILLS, T. A., of Lees, near Oldham, coal merchant	£10,504
BRAIN, J. W. T., ironfounder, of Lansdowne Penn, Wolverhampton	£18,772
CREEK, F., of Walsingham Grange, Harold Wood, Essex, coal merchant	£10,640
EASON, J. W., of Scartho, Great Grimsby, partner in the Wynnfield Iron Company	£5,500.
JAMESON, R., late secretary and commercial manager to Dorman, Long & Company, Limited, Middlesbrough	£17,428
PEPPER, W., a director of R. Roger & Company, Limited, of Stockton, and of Pickerings, Limited, hydraulic engineers, etc.	£5,098
ROWBOTHAM, R., of Scarisbrick New Road, Southport, founder and head of R. Rowbotham, Limited, ironfounders, of Ancoats, Manchester	£27,598
STEAD, DR. J. E., a well-known metallurgical chemist, senior partner in Pattinson & Stead, of Middlesbrough, and a former president of the Iron and Steel Institute	£72,549

XUM

Institute of British Foundrymen.

SHEFFIELD BRANCH.

A meeting of the Sheffield Branch of the Institute of British Foundrymen was held on December 14, the Branch-President (Mr. John Shaw) being in the chair.

Two Papers were read, the first being given by Mr. E. Longden, of Birmingham, on "The Relative Value of Feeding Heads or Denseners (chills) for Grey Iron and Malleable,"* his remarks being illustrated by lantern slides.

The second Paper was read by Mr. H. Bradley on "Relative Values of Feeders and Denseners for Steel." Mr. Bradley said it was improbable that denseners would ever take the place of feeders, but in many types of castings denseners were very useful; almost indispensable.

The densener in many cases saved much machining where the feeder would have to be shaped or planed after the sawing or burning off.

In castings with sections of unequal thickness denseners, internal or external, applied to thick sections regulated the cooling, and therefore made the casting stronger and saved it pulling. Everything depended on the design of the casting to make and the quantity required.

In using internal or external denseners, the greatest care had to be taken to see they were perfectly clean and dry, or trouble would be experienced. The safest plan was to tin the internal ones. External ones should be covered with black lead and dried, or tarred or smoked as a crucible ingot mould. One of the frequent causes of failure was using rusty denseners. Denseners eliminated waste in steel, as in some cases no feeding heads were required; in others it enabled one to put on a much smaller feeder.

Consider an hydraulic cylinder, say with 24 off, weighing approximately 5 tons 10 cwts. The pattern was received with the feeding head on the bottom end of the cylinder. Denseners were made, and fixed round the thicker part, where possible, to enable the steel to freeze quicker at that particular part, therefore tending to equalise the cooling and saving a pull at the junction of the varying thicknesses. After casting a few, in testing them porosity was found in the thinner section where it joined with the press portion, one being a complete waster. The body was parted off at the above-mentioned position, finding four cavities or pipe holes underneath the column boss. It was then decided to cast them the opposite end up, with feeding head, and still using the denseners, at the same time saving 20 cwts. to 25 cwts. of steel in the feeding head without any further trouble.

Mill Pinions.

Here internal denseners were used, so as to save having to put such a large head on the top neck and wobbler, therefore saving much machining, and also getting a much better and stronger neck and wobbler by the grain being closer, owing to it being nearer the casting size. Whenever the pinions were, say, 30 in. and upwards in diameter it was preferable to core them out, in place of using the densener, providing the engineer would allow it, for the bottom wobbler was large enough to allow, say, a 4 to 4½ in. hole through it.

Yoke Castings.

Internal denseners had again to be resorted to in order to solidify the casting and to save much costly shaping if feeders were used. Feeders were fixed on the outer rim portion, also at the feet.

DISCUSSION.

MR. EDGINTON, in opening the discussion, said he had had some experience in the use of chills in cast iron. He thought it was a pity the subject was not more widely known. He remembered when he commenced to use them the considerable difficulty which arose. On a series of castings he used a chill just under the top flange. This practice continued for probably nine or ten days. It was then they encountered some trouble. Six of these cylinders were cast per day. After the first six castings they found the castings began to "kick" or "blow." It was found there was a gas hole in the top of the cylinder above the chill, and eventually it was discovered that the cause of the trouble was that they had used the chills repeatedly, and as a result some oxide formed on them, which reacted with the molten metal. Now, when they had a series of castings they never exceeded five or six times before they used a new set of chills.

MR. S. R. ROBINSON agreed with much Mr. Edginton had said. He thought chills eliminated many troubles in casting. He was of opinion that many of the samples shown on the screen by Mr. Longden could have been overcome with chills and without the difficult method of runners. To his mind, many of the castings he had seen, if they had been top-poured, would have eliminated much trouble so far as the shrinkage holes were concerned. During the war period he had had considerable trouble with the making of cylinders, due to the core. After experimenting, instead of putting in the core, they used a chill, and with chills they cast 100 cylinders without a waster. Then they got a blow on the top, and cast seven more before they got another good one. Chills would only stand using a certain number of times. He broke the chill mentioned, and discovered that every time the chill was used more oxide was formed, and eventually blew the casting. He would like to know the number of times chills could be used.

came from the bottom side of the mould, and pro-

Mould and Metal Gas Reactions.

MR. KAYSER said that while he did not think that anyone would deny that the use of chills would give the results Mr. Longden stated, yet similar results could in numerous instances be obtained by other more suitable and at the same time cheaper methods of procedure.

It was nevertheless interesting to have the different uses of chills brought forward, but he was afraid that Mr. Longden had seriously depreciated the value of his Paper by the strange and, in his (Mr. Kayser's) opinion, erroneous explanations he put forward. There were no grounds whatsoever for the assumption that a gas evolved from the mould whilst the metal was still molten reacted with gases occluded in the metal to give rise to another type of gas which produced blow holes, and until the lecturer could give evidence in support of his contention, he thought it would be best not to advance such an incomprehensible theory.

In the case of cast iron, a chill would, with a suitable mixture of metal, produce a hard surface, but as far as chills were considered that evening, they were considered not so much as surface hardeners but rather as a means of producing sound castings, and in that respect the whole idea in using them was to so control the direction and rate of freezing that no pockets of molten metal were created, as such pockets always gave rise to shrinkage cavities and consequently were a source of weakness.

Mr. Kayser remarked that it was unfortunate that all the castings upon which post-mortem examinations were held were broken open to demonstrate the defects they contained. It was much better to machine castings open, as many shrinkage cavities were quite unoxidised, and although the cavity in the casting may have been as much as ¼ in. across, the two halves were such apparently perfect fitting male and female surfaces that it was impossible to distinguish the fact that they had not been in absolute contact before the casting was ruptured.

MR. DARLEY said, in regard to steel, chills, in his experience, on the outside were not a success unless it was a complete circle. It was essential there should not be any joints, for if there were they produced a pull at each joint. He remembered several instances where they had tried it resulting in curious problems. Gases generally

* This has already appeared in January 11 issue of THE FOUNDRY TRADE JOURNAL.

he thought was on account of the steel having to travel long distances in the mould, and it was not sufficiently liquid to drive out the gas. It was necessary to have many years of experience to understand the mechanism of a steel casting, for although the "drawing" might be carefully examined and every precaution taken, it was so easy to get the casting milled in two pieces. One of the chief arts of the steel moulder is a knowledge of chilling and feeding.

Chilling not Necessarily Hardening.

MR. P. T. BAILEY stated that the principal thing to get impressed on one's mind was the fact that "chill" did not necessarily mean hardness, and if or when, it was generally understood that a casting which had been chilled locally, in say a thick boss adjoining a thin section, the casting might be quite soft and machinable, and also quite sound, then much prejudice would be overcome. The same remark applied to castings made entirely in chills, or permanent moulds. The point should be borne in mind, particularly in castings made in grey iron, and if care was exercised in the proper proportioning of chills and the removal of the chills at the correct temperature, no difficulty would be presented in the subsequent machining operations. In most instances no annealing or other heat treatment should be necessary. In the case of malleable castings, hardness brought about by chilling was of little consequence, as that would be removed in the usual course of annealing. It was in the malleable industry that the use of chills was most valuable, and although chills had been used in some malleable foundries for a good many years, in others their utility was scarcely known, or was only in its infancy. There was a somewhat common impression in some quarters that if a chill was used to prevent drawing or unsoundness, the chill only drove the draw or unsound portion further in. In his opinion that should not occur if the chilling and feeding were done systematically, because it should be possible to run and feed that part of the casting adjacent to the part which had been chilled, and so ensure soundness throughout, even if the chill was not perhaps properly proportioned and made such a course necessary. As far as malleable iron castings were concerned, he would always feed a casting to ensure soundness, in preference to using a chill if it were possible, but in view of the more exacting demands of the engineer and the greater variety of section than formerly, he was satisfied that it was impracticable, if not impossible, to produce some castings of recent design in malleable iron by feeding, or by chilling alone. It was only by using both methods in conjunction that certain modern requirements of the designer might be met. Each had their advantages and disadvantages, but if those were carefully considered it would be found that chills or denseners were a very important and valuable adjunct to the malleable foundry. Using a chill was only a quick method of feeding, and it would be well to emphasise the point.

Chills for Steel Castings.

MR. T. W. BROWN, referring to the use of chills on steel castings, said he was not a great believer in using chills for such a purpose when solidity could be obtained by other means; but where a chill was used, the chill should cover the whole part to be chilled, and it should be all in one piece. One unpleasant experience was the chilling of wheel centres at the arm ends, which was not successful, as they proved to have slight cracks on the rim at the junction of the chill and sand. Some were only slight, and did not show until machined. Another case was the chilling of a hydraulic cylinder, which was chilled around its heavy belt, the chill for this being in segments and somewhat open at the joints. On an examination of the castings, it was found to be cracked at every joint where the chills did not quite meet each other, and that was why he insisted that if chills were used they must be in one piece, and entirely cover the place to be chilled. As to the cause, he thought, at the point where the chill and sand joined each other, they had at one side the metal kept hot by the sand, and on the other the metal solidified by the chill face. As soon as solidification had taken place, contraction commenced, and in this case contracted to centre of chill and the joint between the hot metal kept hot by the sand, and the cooled metal by the face of the chill being the weakest then cracks must develop at that point. That was one of the reasons why he did not approve of chills. Another reason was from an economical point of view. In a foundry it was quite easy to make a chill suitable for many purposes themselves, but in a steel foundry it was a different proposition, as they generally had to get a suitable pattern made and sent out to other foundries to be cast, as not many steel foundries had a metal shop as well as steel.

Fresh Aspects of the Use of Chills.

MR. A. RHYDDERCH said that Mr. Longden had confined himself purely to the production of sound castings in chills, but had unnecessarily complicated the issue by discussing the interaction of gases from the mould and metal in producing unsoundness. The photographs shown on the screen, particularly a few of them, were very obvious cases of piping or liquid shrinkage, which one would expect on casting a solid object, bottom run and thin end up. If Mr. Longden's theory holds, it is impossible to produce a sound casting in sand moulds.

Coming to Mr. Bradley's Paper, numerous instances had been given of the application of chills to various castings, but a large number of the important points had been missed.

For instance, the length and thickness of chill in relation to the size of the job had not been mentioned. Naturally a long chill, due to the unequal heating of the faces, would camber; thin chills would probably burn on; chill cracks are set up if small chills are not accurately jointed, and, finally, chill cracks are set up by over chilling. This is particularly so in hard steels, clinking taking place on subsequent heating. Speaking very generally, the thickness of the chill should approximate to the thickness of the casting, and should be of a double wedge shape, as shown in Fig. A. This type of chill meets most of the above objections.

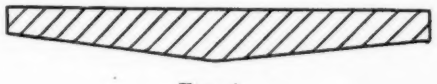


FIG. A.

Another important feature is that it is not so much a question of feeders *versus* denseness, as feeders with denseners or chills. Most foundrymen could call instances to mind where it was imperative to use chills if a solid casting was desired. The use of chills does not diminish shrinkage; it simply accelerates solidification, thereby allowing more effective feeding to take place. Further, it enables the size of the feeder heads to be considerably reduced, resulting in some cases to a saving of 10 to 15 per cent. of metal.

Mr. Longden had mentioned the painting of chills. This is very necessary with old chills, but if they can be thoroughly cleaned, the results are equally satisfactory, unless the moulds are to be dried, when it becomes necessary to paint.

The trouble of pinholes, mentioned by Mr. Edginton, is due to the cracking of the chills, the cracks being filled with oxides.

Regarding the material used for chills, mild and medium carbon steels can be used as well as cast iron. The trouble of cracks does not then arise if the chills are ground before being used.

MR. HYDE said there was one point he would like to mention in connection with cast iron, and that was that the number of times a hematite chill could be used in safety has been known for a number of years. His father had mentioned the subject in connection with hydraulic tools, and he had said they always had trouble if they used a chill too often. He scrapped chills after they had made 30 tools. When old chills were broken there were a series of cracks, and, in addition, the composition was distinctly altered. Some of the silicon had oxidised, and the carbon had almost disappeared. He would like to ask the meeting if they had had any experience of mild steel chills in place of hematite chills, as the alteration due to the oxidation of the silicon and carbon did not apply if the chill was made from steel.

XUM

Trade Talk.

WHITEHEAD IRON & STEEL COMPANY, LIMITED, are laying down a new cold-rolling mill at their Newport works.

HALL, LEWIS & COMPANY, LIMITED, are considerably extending their Crown Wagon and Engineering Works at Maindy, Cardiff.

MR. A. LEVY, iron and steel scrap merchant, of 4, College Street, Swansea, has established offices at 30, City Road, London, E.C.1.

SIR WILLIAM ARROL & COMPANY, LIMITED, have obtained the contract for the Avonmouth Dock extension at Bristol, valued at £554,000.

STEEL, PEECH & TOZER, LIMITED, have received a contract from the Sheffield Corporation for the supply of 800 tons of steel tramway rails at £14 per ton.

JOSEPH KAYE & SONS, LIMITED, of Leeds, have received a contract from the Admiralty for a further supply of their seamless serrated steel (valve) oilcans.

H. B. BARNARD & SONS, metal manufacturers and merchants, have removed their head office from 148½, Fenchurch Street, to 149, Leadenhall Street, London, E.C.3.

MR. D. G. FORSYTH, of 27, Cranford Avenue, Sale, near Manchester, has been appointed agent for A. Hamburger & Company, Limited, metal merchants, New Street, Birmingham.

THE CONTRACT for steelwork for the widening of the Trent Bridge, Nottingham, amounting to £78,709, has been secured by the Cleveland Bridge & Engineering Company, Limited.

THE wages of blast funacemen and ironstone quarry workers in various Midland areas, under the sliding scale arrangements, are to be reduced by 2½ per cent. in the percentage over base rates.

DOUGLAS ELLIOT & COMPANY, LIMITED, iron and steel merchants, Atlas Chambers, King Street, Leeds, have appointed Mr. R. Brown, of 1 and 2, Waterloo Street, Birmingham, their representative for the counties of Warwick, Worcester and Stafford.

THIRTEEN HEAVY broad-gauge locomotives from William Beardmore & Company's works, at Dalmuir, have just been shipped on board a specially designed vessel, in full running order. When delivered they will complete an order for 25 locomotives and tenders for the Bombay, Baroda, and Central Indian Railway Company.

OFFERS BY THE British Thomson-Houston Company, Limited, amounting to £31,794, for supplying one 1,000 k.w. and five 1,500 k.w., rotary converters, have been recommended for acceptance by the Glasgow Corporation Electricity Committee.

THE BRITISH section of the International Metal Workers' Federation has passed a resolution strongly protesting against the action of the Ministry of Labour in exhibiting advertisements at employment exchanges offering employment in France to fitters, turners, mechanics, etc., at wages which they state "would not enable them to contribute towards the support of dependents in this country."

THE steel bar price ascertainment for the three months ended December, 1923, on which the sliding scale in the South Wales Siemens steel trade and the tinplate trade is based, which has just been announced, will cause no change in the wage percentage, the average price being £8 14s. 8½d. The steel percentage will thus remain at 36¼ and the tinplate at 18¾ (which includes the 7½ per cent. special bonus).

THE FEDERATION OF BRITISH INDUSTRIES is informed that all exhibits sent to the British Empire Exhibition by goods and passenger trains will be carried by the railway companies at half rates at owner's risk, and that a similar arrangement will be applied to all returned unsold exhibits. Arrangements have been made for the Exhibition authorities to supply exhibitors with certificates for presentation to the railway companies when traffic is tendered for conveyance on the outward and homeward journeys respectively.

WE REGRET to announce the death of H. E. Diller, of Cleveland, Ohio, a prominent American foundry metallurgist, who was the metallurgical editor of "The Foundry." Mr. Diller was recently appointed a representative of the American Society for Testing Materials on the joint committee, which hopes to work out an internationally acceptable method of testing cast iron following the preliminary steps which took place at the Paris Convention last September. Prior to his connection with "The Foundry," Mr. Diller was an expert on malleable castings and was for many years metallurgist for the American General Electric Company, chiefly at Erie, Pa.

Company News.

Ballard, Richardson & Company, Limited, Garden Walk, Royston, Herts.—Capital £800 in £1 shares. Agricultural machinery makers, etc. Directors: A. P. Ballard, L. Richardson and Josephine Waterton.

Bates Engineering Company (1924), Limited, 47, St. Anne Street, Liverpool.—Capital £5,000 in £1 shares.

Birchfield Engineering Company, Limited.—Capital £15,000 in £1 shares.

Birmingham Railway Carriage and Wagon Company, Limited.—Final dividend of 1s. per share, free of tax, on ordinary capital, making 10 per cent. per annum, free of tax, for year.

Bull's Metal and Melloid Company, Limited.—Dividend, 2½ per cent. for year, carrying forward £494, after transferring £3,000 from reserve, £1,500 from dividend equalisation account, and setting aside £500 for depreciation.

Consett Spanish Ore Company, Limited.—Dividend, 1s. per share.

Corsite, Limited, Richmond Chambers, Richmond Terrace, Blackburn.—Capital £10,000 in £1 shares. Manufacturers of anti-corrosive liquids and a preparation for preventing the over-heating of bearings. Directors: J. W. W. Openshaw, C. W. Eastwood, F. L. Heppard and R. Wilding.

Elliott's Metal Company, Limited.—Interim, 1s. per share on ordinary.

George Heath (1924), Limited, Birmingham.—Capital £40,000 in 20,000 preference shares and 20,000 ordinary shares of £1 each. Engineers. Directors: G. F. Heath (chairman), W. E. Rootes, G. C. Rootes and W. Rootes.

Metal Union, Limited.—Capital £20,000 in £1 shares. Directors: P. Bass, 60-70, Mark Lane, London, E.C., metal merchant, and G. E. Compson.

Mond Nickel Company, Limited.—Interim dividend, 5 per cent. on ordinary.

Staveley Coal & Iron, Limited.—Interim dividend, 6d. per fully-paid share and proportionately on the partly-paid shares, equivalent to 5 per cent. per annum, free of tax.

Stringer Bros. and Matty, Limited, 178, Aston Road, Birmingham.—Capital £2,000 in £1 shares, to acquire the business carried on under the style of T. Stanley & Company, brassfounders. Directors: J. Stringer and T. Matty.

Walkers (North Walsham), Limited.—Capital £5,000 in £1 shares. Engineers.

Yorkshire Railway Wagon Company, Limited.—Amount available for distribution (after paying of interest on debentures and loans), £39,719; interim dividend paid, £9,375; further dividend of 2s. on 75,000 shares (£2 paid), and 1s. on the 37,500 shares (£1 paid), £9,375; bonus, £4,687; to reserve, £10,000; carry forward, £6,146.

Contracts Open.

Belfast, February 13.—Stores, for the Belfast and County Down Railway Company, viz.:—(1) Iron; (2) iron castings; (4) bolts, spikes, etc.; (5) tyres and axles; (6) springs, steel and files; (7) nails, screws, etc. The Storekeeper, Belfast Terminus.

Birkenhead, February 19.—Stores, as required at the tramway depôts during year ending March 31, 1925, for the Corporation:—Wrought-iron and steel bars and charcoal sheets; iron, brass and gunmetal castings; overhead line material; steel tyres, axles and pinions; bolts, nuts, files, twist drills, etc. The General Manager, Corporation Tramways and Motors, Laird Street, Birkenhead.

Liverpool, February 14.—Wrought-iron lamp standards, cast-iron lamp columns, for the Corporation. The City Lighting Engineer, 15, Highfield Street, Liverpool.

London, E.C., February 13.—Stores, for the Metropolitan Water Board. The Chief Engineer, Metropolitan Water Board, New River Head, 173, Rosebery Avenue, E.C.1.

Metton, near Cromer, February 16.—Pumping machinery, for the Cromer Urban District Council. J. C. Melliss & Company, 156, Gresham House, Old Broad Street, London, E.C.2. (Fee, £5, returnable.)

Sheerness, February 11.—Supply of approximately 25 tons of 3-in. cast-iron pipes and specials, for the Sheerness Urban District Council. The Surveyor, Council Offices, Sheerness.

Thorpe, Norwich, February 26.—Manufacture and erection of (f) two 24-in. and one 3-in. electrically-driven centrifugal pumps; (g) extra-high-pressure, remote controlled main switchgear, etc.; (h) overhead mono-rail telpher coal-conveying plant; (i) four steel (alternatively cast-iron) tube fuel economisers, two steel chimneys, four electrically-driven suction draught fans, etc., for the Corporation. Preece, Cardew & Rider, 8, Queen Anne's Gate, London, S.W.1. (Fee, £2, returnable, for each section.)

XUM

MACNAB & Co.

TABOR MOULDING MACHINES (TABOR PATENTS)

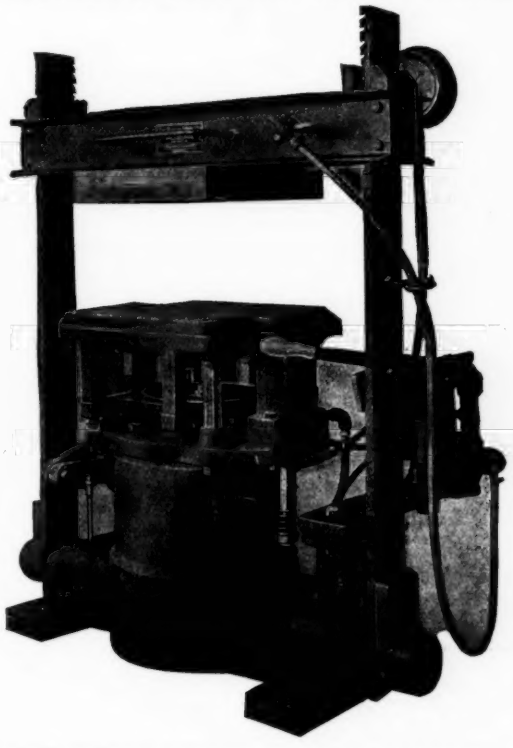
For Every Class of Work.

Pit Type and Portable Combination Shockless Jar Ramming Power Roll-over and Pattern Drawing Machines; Power Squeezing and Jar Squeezing Machines; Shockless Jarring Machines, etc., etc.

SPECIAL FEATURES AND ADVANTAGES:

Accurate Definite Draw with Permanent Accurate Alignment.

All Operations Controlled by One Lever.



Uniformity in size of Castings produced.

All Moulds squeezed alike to whatever Pressure Required.

Minimum Percentage of Wasters.

The above illustrates the TABOR POWER SQUEEZING "SPLIT PATTERN" MOULDING MACHINE, specially suitable for all small patterns which can be split in halves or for flat back Work.

A customer writes—

"The Machines draw perfectly in producing deep castings with the minimum amount of taper, and we are fully satisfied with them, as they are most economical in use and give the maximum production."

Capacities and Dimensions furnished upon application:

56/8, Eagle Street, Southampton Row, London, W.C.1.

Works: TOTTENHAM, LONDON, N.17.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Business in the Cleveland iron market during the current week, though quiet on the whole, has been steady, with few developments of more than passing interest, supplies having been maintained in full volume, with furnace outputs again at normal There are, however, few fresh contracts coming forward at the moment, due doubtless to buyers' realisation of the uncertainty of the general position, while to add to the difficulties of the moment is the widespread impression in market circles that prices must come down to lower levels in the near future. That such a movement is practically inevitable in the face of the increasing foreign competition is now admitted, the recent sharp decline in the value of the franc being alone sufficient to justify apprehension on that score. Political developments at home are also a factor to be regarded seriously, and until clearer indications of the attitude of the present Government with regard to national financial questions are disclosed a certain amount of nervousness is quite justifiable.

The hematite market is rather weaker, and it is doubtful whether current consumption is now absorbing outputs. New business in the home trade has declined since the beginning of the year, and in the export trade, while some fair individual lots have been disposed of, transactions are checked by the lower-priced French hematite which is offering.

MANCHESTER.—In this area demand for foundry pig-iron remains practically stationary, and it is regarded as unlikely that any change of importance is imminent at present. Expert market opinion at the moment is inclined to the conviction that an essential requirement of improvement is a general revival of demand for ordinary foundry work, so that all the smaller foundries may have plenty of work in hand; but this we do not see.

THE MIDLANDS.—Business in this district remains quiet, the demand for foundry iron having declined to some extent, while it is the confident belief of many of the largest consumers that before long the prices will drop, this in spite of the fact that they are aware that coke is in very strong demand, supplies are inadequate for the needs, and that premiums of anything from 2s. to 7s., are being asked over the figure of 24s. at ovens, which was the price arranged to obtain until the end of March.

SCOTLAND.—At Glasgow last week there was very little fresh business moving, home consumers having already apparently bought to the limit of their requirements for the current quarter, and showing a disinclination to undertake further commitments. Foreign competition is again upon the increase, and offers of Continental pig-iron are reported at a considerable discount upon current home quotations.

Finished Iron.

In the manufacturing branches of the iron trade, conditions remain fairly satisfactory, with prices of marked and crown bars unchanged. At the Birmingham market last week the demand for this class of material was steadily maintained, and there is no sign of any lower figure being taken, although forge iron is 1s. or so per ton less than has been the case for a few weeks. The marked-bar manufacturers report that business is coming through regularly, and find no difficulty in securing orders at the prices previously quoted. It is the manufacturers of nut and bolt iron who are feeling the Continental competition, which of late weeks has become more pronounced. Continental iron can be purchased quite freely at £2 10s. to £3 per ton lower than the English price. No better price than £11 can be obtained by local manufacturers, whereas Belgian supplies are being offered at £8 7s. 6d. to £8 12s. 6d. delivered South Staffs. stations.

Steel.

The market for steel and its products continues steadily active, and at Sheffield reports are favourable to an early extension of business, manufacturers expecting a good deal from the proposal to give full recognition to Russia, for that country's need for goods which Britain can supply is known to be very large. Billets, both acid and basic, are firm, with no alteration in prices. The talked-of Continental competition has not had much effect here so far, but it is realised that our export trade may easily become more difficult in consequence, and a considerable tonnage of billets has been sold to re-rollers in the Yorkshire district at as low a price as £6 8s. 6d. delivered. Probably even lower prices would now be quoted. The general tone of the tinplate market is good, and prices are quite firm all round; 24s. has again been taken for second-hand lots, but there are not many sellers at this, and 24s. 3d. has been paid in many cases for February to May delivery. The inquiry is rather better all round, and a fair proportion of business has resulted.

Scrap.

The after-effects of the railway strike have been, perhaps, more severely felt in the case of scrap material markets than in other branches of the iron and steel trade, and business, consequently, has much disappointed expectations. In the Lancashire districts the demand for cast scrap by ironfounders continues on a limited scale, while dealers evidence little inclination to buy, even by putting down prices. These are low enough as it is, and with good broken machinery metal selling at 10s. to 15s. below the cost of common foundry pig, there is nothing in the prices to prevent a large business. This is the reason why the belief is growing that ironfounders generally have not much work in hand. In Scotland the position of the iron foundries is somewhat unsatisfactory as far as the demand for scrap materials is concerned, as they are relying on getting deliveries of Continental pig. Small quantities have changed hands recently at around 100s. to 102s. 6d. per ton for heavy machinery cast-iron scrap and ordinary cast-iron scrap about 90s. to 92s. 6d. per ton, according to quality. Light metal and furnace firebars quote about 75s. per ton.

Metals.

Copper.—Consequent upon the recent recovery in the value of sterling in the United States, prices of standard copper on this side have evidenced a lower tendency, the advance registered last week having entirely disappeared. At present the general copper position in America does not engender real confidence into any but the most casual observer. Production is proceeding apace both in North and South America, but even if American consumption should be stimulated in the near future, as a result of a possible spring business boom, there is no guarantee yet that Europe will be able to do her share to restore the situation to a sounder condition by taking metal on a more widespread scale. Current quotations :—*Cash* : Thursday, £65 5s.; Friday, £60 17s. 6d.; Monday, £60 10s.; Tuesday, £60 15s.; Wednesday, £60 17s. 6d. *Three Months* : Thursday, £62; Friday, £61 12s. 6d.; Monday, £61 7s. 6d.; Tuesday, £61 12s. 6d.; Wednesday, £61 12s. 6d.

Tin.—During the past week the market for standard tin developed considerable irregularity, consequent upon realisations on speculative account, and some "bear" selling occasionally in evidence. Disappointment was also expressed on the announcement of the January statistics, which were less favourable than had been generally anticipated. It was, of course, expected that "visible supplies," mainly on account of the heavy Eastern shipments during January, would show a striking increase, and their actual expansion to the extent of some 2,500 tons to about 21,200 tons merely confirmed the expectations of the market, but the somewhat unwelcome discovery was assimilated with a comparatively good grace. The general feeling is still fairly hopeful, however, and there is a tendency to ignore setbacks to the statistical position as being intrinsically of a temporary and technical nature and without real significance. Current quotations :—*Cash* : Thursday, £253 10s.; Friday, £251; Monday, £251 5s.; Tuesday, £257 5s.; Wednesday, £259 5s. *Three Months* : Thursday, £253 10s.; Friday, £251; Monday, £251 5s.; Tuesday, £256 5s.; Wednesday, £257 15s.

Spelter.—The market for this metal continues firm and steady, though towards the close of the week some reaction in prices was noted. Rudolf Wolff & Company report that inquiry on the part of consumers has slackened off again, which is in a measure due to the labour difficulties and the fear that galvanisers here and there might have to partly close down in consequence of shortage of fuel. On the Continent the market remains quietly steady. In America rather firmer conditions have prevailed consequent on improving domestic demand. Current quotations :—*Ordinary* : Thursday, £35 5s.; Friday, £35 5s.; Monday, £35 2s. 6d.; Tuesday, £35 2s. 6d.; Wednesday, £35 2s. 6d.

Lead.—Business in soft foreign pig during the past week continued steady. Demand on the part of consumers remains quiet, but it is anticipated that this will shortly improve again, and sellers therefore adopt a cautious attitude, the more so as some uncertainty still surrounds the position as regards supplies. Current quotations :—*Soft foreign (prompt)* : Thursday, £32 10s.; Friday, £32 17s. 6d.; Monday, £32 17s. 6d.; Tuesday, £32 12s. 6d.; Wednesday, £32 17s. 6d.